



**REAL WORLD EDUCATION.
REAL WORLD APPLICATION.**

**2026
EDUCATION
CATALOG**

MOTION + POWER
MANUFACTURERS ALLIANCE™





April 23-25, 2026
Sunseeker Resort
Charlotte Harbor, FL

MOTION + POWER

MANUFACTURERS ALLIANCE™

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MPMA FOUNDATION

The development of MPMA's Workforce Education Series, Operator Level Courses, and Online Video Training Courses—Detailed Gear Design, Gear Failure Analysis, and Gearbox CSI—are made possible through the generous support of the MPMA Foundation.

Over the past 25 years, the Foundation has raised more than \$2.5 million to fulfill its mission of providing support to the gear industry.

Contact Mary Ellen Doran, AGMA Foundation, Executive Director, at *doran@motionpower.org* for more information and how you can participate in the annual campaign.

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American Gear
Manufacturers
Association



AGMAvideo



@cheers4gears



MPMA Education Department Mission and Certificate Programs

The MPMA Education Department conducts programs that support the professional development of the gear and bearing manufacturing workforce. Classes are available at all levels of experience, from operator to engineer. We provide a variety of learning environments to reach our learners anytime, anywhere, including self-paced on-demand, live online, and in-person courses. We are the leader in gear and bearing education in the United States, and are committed to providing relevant opportunities with an emphasis on learning outcomes and the application of knowledge to meet employer and learner needs.

OUR GOALS ARE TO:

- ▷ Deliver training and education opportunities that build a knowledgeable, skilled workforce to more effectively and efficiently meet critical goals.
- ▷ Continually enhance the quality of the learning environment and the diversity of learning approaches to meet the needs of learners.
- ▷ Ensure that learning opportunities remain relevant.
- ▷ Continually assess and improve courses to ensure desired learning outcomes are met.
- ▷ Attract, develop, and retain highly qualified instructors from diverse backgrounds who are committed to providing supportive learning environments specific to gear manufacturing.

MPMA HAS ESTABLISHED POLICIES ON:

- ▷ Student Record/Information Privacy
- ▷ Anti-Harassment/Discrimination
- ▷ Intellectual Property
- ▷ Proprietary Interest

For detailed information on such policies, please contact the Education Department at: education@motionpower.org.

MPMA Certificate Programs

A leader in gear education, MPMA continues to expand our course offerings to meet the needs of the gear and bearing industries. We offer two certificates which include the following:

GEAR MANUFACTURING CERTIFICATE

- ▷ Basic Training for Gear Manufacturing
- ▷ Fundamentals of Gear Design and Analysis
- ▷ Gear Manufacturing and Inspection
- ▷ Two additional advanced courses in face-to-face or live, instructor-led virtual formats

ADVANCED GEAR ENGINEERING CERTIFICATE

Any combination of five advanced courses in face-to-face or live, instructor-led virtual formats

ADVANCED COURSES

- ▷ Gear Failure Analysis
- ▷ Gearbox CSI
- ▷ Gear Manufacturing and Inspection
- ▷ Gearbox Systems Design
- ▷ Steels for Gear Applications
- ▷ Detailed Gear Design
- ▷ Epicyclic Gear Design
- ▷ Bevel Gear Design
- ▷ Worm Gear
- ▷ Gear Systems Design for Minimum Noise
- ▷ Gear Materials

NOTE: On-Demand Video courses do not count towards either certificate unless prior MPMA approval has been provided to you. If seeking prior approval, please email education@motionpower.org.

More than 3,000 individuals have completed courses through the MPMA Education Department. For those select students who have completed a certificate program, taking the series of courses required consisted of more than 90 hours of classroom instruction.



WORKFORCE Training Series

ONLINE WORKFORCE TRAINING SERIES

The Workforce Training Series provides a comprehensive overview of gearing to enhance students' understanding of essential terminology and practices within the industry.

FUNDAMENTALS OF GEARING

FREE for MPMA Members | Non-Member

Fee: \$395/course

This course is a comprehensive overview of the industry. It begins with a little history of gearing and proceeds through the topics of:

- ▷ Parallel axis gear basics
- ▷ Involute tooth form
- ▷ Description of the gear
- ▷ Diametrical pitch/Module
- ▷ Pitch
- ▷ Pressure angle

And then finishes by defining a series of 37 crucial terms used in gearing.

Students will also receive a copy of the *ANSI/AGMA 1012-G05 Gear Nomenclature, Definitions of Terms with Symbols*. (\$78 value)

PARALLEL GEAR INSPECTION

FREE for MPMA Members | Non-Member

Fee: \$395/course

The level one gear inspection module includes basic concepts for gear measurement, the tools and instruments used, the evaluation of gear characteristics, definitions of terms, and an introduction to gear quality classification.

Topics covered include:

- ▷ Categories of measurement
- ▷ Double flank composite inspection
- ▷ Single flank composite inspection
- ▷ Sequence of measurements
- ▷ Mean helix slope deviation
- ▷ Gear quality classification

FUNDAMENTALS OF HOBBING

FREE for MPMA Members | Non-Member

Fee: \$395/course

This course is designed to present the basics of hobbing to hobbing machine operators, gear technicians, and engineers. It covers the following material:

- ▷ Hobbing process
- ▷ Hob cutting tool terminology
- ▷ Generating gears
- ▷ Hobbing machine terminology
- ▷ Measuring, mounting, and truing the hob
- ▷ Mounting and truing the work piece
- ▷ Basic part inspection
- ▷ Tooth size, runout
- ▷ And how to recognize problems

Need introductory information on gears for your employees?

This is a perfect starting point for new beginners!

HEAD TO OUR WEBSITE, agma.org, to register!



ON-DEMAND Education Offerings

ONLINE ON-DEMAND VIDEO TRAINING COURSES

DETAILED GEAR DESIGN: BEYOND SIMPLE FACTORS

Member Fee: \$1,095 | Non-Member Fee: \$1,595

GEAR FAILURE ANALYSIS

Member Fee: \$995 | Non-Member Fee: \$1,495

GEARBOX CSI: GEARS ONLY

Member Fee: \$795 | Non-Member Fee: \$1,295

BASICS OF GEARING

Member Fee: \$795 | Non-Member Fee: \$995

HOW TO READ AND INTERPRET A GEAR INSPECTION CHART

Member Fee: \$300 | Non-Member Fee: \$400

ARCHIVED WEBINARS

LIVE WEBINARS

FREE for MPMA Members | Non-Member Fee: \$159/course

MPMA has many options for webinars - from emerging technology and marketing, to the economy and state of the gear industry. Join us for a topic that interests you!

FOR PREVIOUSLY RECORDED WEBINARS

FREE for MPMA Members | Non-Member Fee: \$159/course

All sessions are recorded and sessions and handouts are available as on demand downloads.

*For more information on
MPMA's ON-DEMAND
opportunities
VISIT agma.org*

2026 Fall Technical Meeting

October 5-7, 2026
Hilton Rosemont-Chicago O'Hare

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BASIC LEVEL Course offerings

ANALYTICAL GEAR CHART INTERPRETATION

4 Clock Hours
February 24, 2026
June 23, 2026

LIVE Online



Instructor: Dwight Smith

Member Fee \$375 | Non-Member Fee \$475

This course is an introduction to the methodology of analytical gear inspection and the evaluation and interpretation of the resulting data. The application of this information to identify and correct manufacturing errors will begin to be explored. Additionally, it reviews chart interpretation and applies inspection data to understand the causes and cures of manufacturing errors. Many chart examples are used to understand cause and effect.

LEARNING OBJECTIVES

- ▷ Identify major gear characteristics measured and methods used.
- ▷ Evaluate pitch, profile and helix. Use AGMA ANSI ISO analysis methods.
- ▷ Compare and contrast 2008-A88 with the current standard AGMA ANSI ISO 1328-1-B14.
- ▷ Understand errors from various gear manufacturing processes: hobbing, shaping, shaving, and grinding.
- ▷ Understand the relationship between inspection charts and manufacturing kinematics.
- ▷ Use inspection chart information to determine the root causes of errors.

DESIGN BASICS OF SPUR AND HELICAL GEARS

4 Clock Hours
February 25, 2026
July 13, 2026

LIVE Online



Instructor: Terrance Klaves

Member Fee \$375 | Non-Member Fee \$475

Learn how to develop and understand customer gear drive application specifications and target performance expectations. Review, calculate and select basic gear terminology variables and design parameters which define tooth bending and contact rating safety factors using two real-life examples. Learn how to optimize gear fatigue safety factors for a given target design life and fit new gear designs and ratios into existing center distance using profile shift. Use commercially available software to develop gear geometry factors, calculate and optimize gear set power density and performance. Review common gear failure modes if the design or final accuracy does not meet application requirements. Discuss time and cost of more than 20 other gear drive component functions and drive development steps through prototypes to shipment of compliant assembled production drives. There will be an opportunity to discuss gear design challenges which may be unique to participant industries.

LEARNING OBJECTIVES

- ▷ Discuss aspects of gear tooth fatigue loading and typical failure modes as a basis for gear designs which exceed target design fatigue life.
- ▷ Understand the various forms of drive loads.
- ▷ Ability to start with customer supplied gear drive application specification and develop an optimized gear design which meets or exceeds application and performance requirements.
- ▷ Review gear geometry terminology and design optimization variables beyond information available in Machinery's Handbook, apply optimization tools currently used in industry.
- ▷ Calculate contact and bending safety factors as (material and design allowable loads) divided by (application loads) for a target design life.
- ▷ Learn how to fit a new gear ratio into existing housing and center distance.

**SIGN UP
for courses at
agma.org**



**BASIC LOADED
TOOTH CONTACT
ANALYSIS
THEORY**

4 Clock Hours
February 26, 2026
July 16, 2026
LIVE Online

Instructor: Terrance Klaves

Member Fee \$375 | Non-Member Fee \$475

Evaluate loaded tooth contact and develop tooth modifications using commercially available software to improve K_{hb} and optimize power density. Two real life gearing examples will be presented in the course: one will have a cantilever mounted pinion, the other a shaft pinion straddled non-symmetrically by bearings. Both examples demonstrate component deflections under load which significantly reduce tooth mesh contact which is then corrected with developed helix and profile modifications. Other gear performance optimization tools will also be briefly discussed, profile shift, isotropic finishing, shot peening, accuracy, material selection.

LEARNING OBJECTIVES

- ▷ Identify the need for contact analysis and describe the theory behind the contact analysis process.
- ▷ Model the loaded gear mesh shafts, bearings and gear geometry in commercially available dedicated gearing “FEA” software to calculate magnitude and direction of tooth deflections and deformations.
- ▷ Develop tooth profile and helix modifications that compensate for tooth deflections, reducing transmission error and optimizing power density.
- ▷ Describe the tools and processes of contact analysis.
- ▷ Review cantilever pinion example of contact analysis and corrective action.
- ▷ Review non-symmetrical bearing mounted shaft pinion example of contact analysis and corrective action.
- ▷ Present contact analysis Do's and Don'ts.
- ▷ Review other gear performance optimization tools.



**BASIC TRAINING
FOR GEAR
MANUFACTURING**

30 Clock Hours
April 13-17, 2026
**September 28-
October 2, 2026**
Chicago, IL

Instructors: Dwight Smith, Peter Grossi and Robert Waselewski

Member fee \$2,195 | Non-Member Fee \$2,695

Learn the fundamentals of gear manufacturing in this hands-on course. Gain an understanding of gearing and nomenclature, principles of inspection, gear manufacturing methods, and hobbing and shaping. Utilizing manual machines, develop a deeper breadth of perspective and understanding of the process and physics of making a gear as well as the ability to apply this knowledge in working with CNC equipment commonly in use.

This course is taught at AGMA National Training Center.

LEARNING OBJECTIVES

- ▷ Demonstrate understanding of the evolution, history, and function of gears.
- ▷ Show and describe 14 gear tooth features.
- ▷ Describe six typical gear characteristics that are measured.
- ▷ Demonstrate knowledge of gauging vs. measurement.
- ▷ Utilize and describe a variety of analysis methods.
- ▷ Understand processes to troubleshoot problems.



A PRACTICAL APPROACH TO MANAGING GEAR NOISE

8 Clock Hours
May 12-13, 2026

LIVE Online



EV AUTOMOTIVE TRANSMISSION SYSTEM DESIGN

24 Clock Hours
May 19-21, 2026

Schaumburg, IL

Instructor: Robert White

Member Fee \$650 | Non-Member Fee \$750

This course combines theory with practical testing and simulation techniques used to manage gear noise. Topics focus on insights into the mechanisms for both whine and rattle, the two most common categories of gear “noise”. The course presents clear explanations relating subjective evaluations of audible noise to objective actions, including troubleshooting and countermeasures. Concepts are supported with a number of sound and movie files. Technical papers supporting certain concepts are cited for the students’ further study.

LEARNING OBJECTIVES

- ▷ Explanation of the underlying physics of gear noise generation mechanisms for whine and rattle
- ▷ Exposure to vibration and sound instrumentation and testing techniques used to characterize whine and rattle
- ▷ Introductions to advanced simulation tools for understanding the underlying physics of gear whine and rattle, with insight into troubleshooting and countermeasures.

Instructor: William ‘Mark’ McVea, PhD, P.E.

Member Fee \$2,250 | Non-Member Fee \$2,750

Transmissions (MTs) and / or Automatic Transmissions (ATs) is the lack of the ‘noisy’ internal combustion engine or ICE motor. An internal combustion engine driving into a typical gearbox provides a great deal of NVH masking. Thus, we obviously need to design quieter gearboxes to reduce the potential of observed gearbox NVH, now potentially unmasked by the lack of the ICE signature and magnitude. However, and moreover, the signature from an ICE is much different than from the electric motor. The new input signature, frequency, and magnitude, cause a shift to higher frequencies and generally lower magnitudes of vibrational energies. That in turn becomes a more significant consideration in terms of gear design and application. We will discuss this and more throughout the course.

LEARNING OBJECTIVES

- ▷ Extend our understanding of beneficial effects and uses of gear microgeometry to the new EV application.
- ▷ Incorporate design and application considerations of bearings, shafts, and seals to development and integration of EV transaxles.
- ▷ Appreciate the new, more expansive requirements for the lubricant and coolant.
- ▷ Discuss added application requirements and their effect on design and development.
- ▷ Summarize design and development requirements as a function of the additional constraints presented by the EV driveline.



FUNDAMENTALS OF PARALLEL AXIS GEARING

24 Clock Hours
June 2-4, 2026

Clearwater Beach, FL



OPERATOR GEAR GRINDING

8 Clock Hours
July 21-22, 2026

LIVE Online

Instructor: William 'Mark' McVea, PhD, P.E.

Member Fee \$2,250 | Non-Member Fee \$2,750

Gain a solid and fundamental understanding of gear geometry, types and arrangements, and basic design principles. Starting with the basic definitions of gears, conjugate motion, and the Laws of Gearing, learn the tools needed to understand the interrelation and coordinated motion operating within gear pairs and multi-gear trains. Basic gear system design process, gear measurement and inspection techniques will also be explained. In addition, the fundamentals of understanding the stepwise process of working through the iterative design process required to generate a gear pair will be reviewed. An explanation of basic gear measurement techniques, how measurement equipment and test machines implement these techniques, and how to interpret the results from these basic measurements will also be covered. Finally, a brief overview of in-service failure modes and causes.

LEARNING OBJECTIVES

- ▷ Develop a full appreciation for the meaning and correct use of gear nomenclature.
- ▷ Describe conjugacy and its relationship to transmission error.
- ▷ Appreciate and correctly select the basic geartrain arrangements as a function of application.
- ▷ Be able to describe and discuss the external factors that effect a gear pair and / or a geartrain.
- ▷ Be able to describe and discuss the various common manufacturing techniques for gears.
- ▷ Describe the measurement and inspection techniques used to qualify a gear.
- ▷ Develop a high-level of appreciation for various gear failure modes and causes.

Instructor: Terrance Klaves

Member Fee \$650 | Non-Member Fee \$750

Explore precision gear grinding processes, machine input variables, kinematics in Part A, Grinding simulation, machine alignment, setup errors, pitfalls, common gear fatigue failures and expectations related to finish ground gearing will be covered in Part B. Learn definitions of gearing component features, application loads and process steps from blanking, through heat treatment to finished part ready to ship. Study aspects of Quality Assurance, Inspection Documentation and corrective actions for measured non-conformances. Understand pre-heat treat, heat treatment distortion and post heat treatment operations, including the how's and why's to produce finished gears that conform and perform to end user expectations. Calculate gear form grinding cycle times for real life examples at various accuracy levels on commercially available software.

LEARNING OBJECTIVES

- ▷ Review and challenge control of part datums for pre-heat treatment operations, use datums consistently through finishing operations given part prints.
- ▷ Anticipate and correct for part distortion during heat treatment knowing the actual heat treatment process used.
- ▷ Understand gear grinding kinematics for both form and generating machines along with allowable metal removal rates and wheel dressing intervals based on type of grinding wheels being used.
- ▷ Ask questions of gear designers and manufacturing engineers to acquire all information required to produce conforming finished gears.
- ▷ Accurately apply and inspect pre-calculated micro-geometry modifications derived from complex contact analysis software.

ESSENTIAL CONCEPTS OF BEARING TECHNOLOGY

24 Clock Hours
August 4-6, 2026

Charlotte, NC



Instructors: Daniel Snyder, Timothy Ovaert, and Vern Wedeven

Member Fee \$2,450 | Non-Member Fee \$2,750

This course is specially designed for engineers and others with technical backgrounds that have had limited exposure to rolling element bearings and need to adapt their technical training to bearings or seek an upgrade to their technical knowledge. The Essentials Course focuses on understanding basic internal geometry, tribology, bearing attributes and applications and explores the basic concepts around manufacturing methods, loads, internal load contacts, lubrication and failure..

LEARNING OBJECTIVES

- ▷ Basic understanding of the different types of rolling element bearings and their applications.
- ▷ Basic understanding bearing loading types and their sources.
- ▷ Understanding of the load distribution within bearings and resulting contact stresses.
- ▷ Understanding the types of internal stresses and bearing load ratings.
- ▷ Understanding of why bearings fail.
- ▷ Understanding of how lubricant films are developed in the rolling element contacts.
- ▷ Understanding of the importance of lubrication on bearing life.
- ▷ Basic understanding of bearing deflections and preload.
- ▷ Understanding of bearing life calculations used in standards.
- ▷ Introduce bearing materials and standards overview.

FUNDAMENTALS OF WORM AND CROSSED AXIAL HELICAL GEARING

24 Clock Hours
August 4-6, 2026

Charlotte, NC



Instructor: Lance Brown and William "Mark" McVea, PhD, P.E.

Member Fee \$2,250 | Non-Member Fee \$2,750

This course is intended to be both an overview of worm and wheel gearing, as well as an introduction to the application, design considerations, practical development techniques for manufacturing, and finally how best to apply worm and wheel technology. We will cover some design development, lubrication considerations, and failure modes and causes.

LEARNING OBJECTIVES

- ▷ Gain a basic appreciation for worm and wheel technology.
- ▷ Understand the reasoning behind the application of this technology.
- ▷ Be able to surmise the design requirements of worm and wheel gearing as a function of the application.
- ▷ Understand lubrication requirements and articulate those to the gearbox designer.
- ▷ Benefit from a review of failures and failure modes.



HOW TO READ AND INTERPRET A GEAR INSPECTION REPORT

8 Clock Hours
September 1-2, 2026

LIVE Online



DESIGN AND PERFORMANCE RATING PROCEDURES FOR PLASTIC GEARS

8 Clock Hours
November 2-3, 2026

LIVE Online

Instructor: William 'Mark' McVea, PhD, P.E.

Member Fee \$650 | Non-Member Fee \$750

This half-day, online seminar is intended to provide you with a thorough understanding of the information contained within a typical gear inspection report. Specifically, we will look at the contents and meaning of the information contained within the gear charts, as well as the techniques used by the gear measurement system to assess gear quality. An explanation of basic gear measurement techniques, how measurement equipment and test machines implement these techniques, and how to interpret the results from these basic measurements will be covered. We will also discuss how to interpret the results and what corrective actions may be considered if the quality of a particular gear is unsatisfactory.

LEARNING OBJECTIVES

- ▷ Describe the measurement and inspection techniques used to qualify a gear.
- ▷ Explain the major contributing factors to gear quality.
- ▷ Describe in detail the practical gear measurement and inspection techniques.
- ▷ Categorize the common tools and equipment used to measure and inspect gears.
- ▷ Discuss some of the new and automated gear design systems.

Instructor: Damijan Zorko and Borut Cerne

Member Fee \$650 | Non-Member Fee \$750

High performance plastic gears are increasingly replacing metal gears in several applications due to many advantages they exhibit. Main ones are having lower weight, no need for lubrication, cheaper mass production, significantly better noise, vibration and harshness (NVH) behavior and chemical/corrosion resistance.

Design methods for plastic gears are in many ways different and more complex to those for steel gears. In major part the complexity is to be attributed to the material's temperature-dependent properties. Also the production methods are different, which needs to be taken into account during the design phase. The majority of plastic gears are produced by injection molding, which enables great design flexibility, e.g. joining several machine elements into one molded part, as well as a wide range gear geometry modifications.

The course focuses on all aspects of the design process of gearboxes with plastic gears. The covered topics were selected based on state-of-the-art industrial projects, working with stakeholders from automotive, micro-mobility (e-bikes), house appliances, aerospace, chemical, power tools and robotics sectors.

LEARNING OBJECTIVES

- ▷ Understanding the differences in operation, design and production, between the plastic and metal gears
- ▷ Appropriately select materials and lubrication type for a plastic gear application
- ▷ Reliably design gear transmissions with plastic gears, taking into aspect all possible failure modes which could occur during operation of their product, as also other important customer requirements, e.g. NVH.

ADVANCED LEVEL Course Offerings



GEARBOX CSI

24 Clock Hours
February 3-12, 2026

LIVE Online



BEVEL GEAR SYSTEMS DESIGN

24 Clock Hours
March 2-6, 2026

LIVE Online

Instructors: Raymond J. Drago, P.E. and Joseph W. Lenski, Jr.

Member Fee \$2,050 | Non-Member Fee \$2,550

A good understanding of individual failure modes and the failure scenarios that led to the actual system failure is an essential skill to designing gear and bearing systems that will operate properly for their full design life. In this course, we will define and explain the nature of many gear and bearing failures, as well as describing various actual failure scenarios. In addition, a detailed primer on bearing technology prefacing the failure scenario discussions. You will gain a better understanding of various types of gears and bearings. Learn about the limitation and capabilities of rolling element bearings and the gears that they support. Grasp an understanding of how to properly apply the best gear-bearing combination to any gearbox from simple to complex.

LEARNING OBJECTIVES

- ▷ Apply understanding of forensic analysis of gearbox failures in future gearbox designs.
- ▷ Discuss bearing and gear types.
- ▷ Explain how bearing selection is influenced by gear type and loading.
- ▷ Select appropriate bearing types and configurations as influenced by gear type and loading.
- ▷ Explain how to optimize bearing and gear combination.
- ▷ Identify seven materials and manufacturing related defects.

Instructors: Raymond J. Drago, P.E.

Member Fee \$2,050 | Non-Member Fee \$2,550

Learn how to design and apply bevel gears systems from the initial concept through manufacturing and quality control and on to assembly, installation and maintenance. Engage in a practical hands-on guide to the bevel gear design, manufacture, quality control, assembly, installation rating, lubrication and, most especially, application.

LEARNING OBJECTIVES

- ▷ Apply the selection process required to determine which type of bevel gear is best for a particular application.
- ▷ Integrate both the manufacturing and quality control processes in the initial design process.
- ▷ Draw upon how bevel gears are manufactured to design these gears FOR manufacturability and good quality control.
- ▷ Discuss best practices for mounting, assembling and installing bevel gears.
- ▷ Discuss requirements and practices for lubrication and maintenance.
- ▷ Draw upon the relationship between standard rating practices and actual bevel gear tooth stresses as a means of optimum design.
- ▷ Describe in-service lubrication and maintenance required to support long term operation.

HIGH PROFILE CONTACT RATIO GEARING

3 Clock Hours
March 24, 2026

LIVE Online



Instructors: Raymond J. Drago, P.E.

Member Fee \$375 | Non-Member Fee \$475

High Profile Contact Ratio (HCR) gears, both spur and helical, have been shown to provide significant reductions in gear mesh frequency noise and vibration levels and, depending on the specific configuration, improved load capacity as well. The design of HCR gears is, however, far from a simple task and must be carefully accomplished. In addition, HCR gears are not appropriate for every circumstance.

In this seminar we will learn just what HCR gears are and under what circumstances they can be used to advantage. Similarly, we will learn when HCR gears are not appropriate and why. We will cover the detailed tooth geometry changes that are required to effectively achieve optimum performance and benefit. We will learn how the load distribution along the involute profile changes when the contact ratio increases above two.

Because of the longer, more slender teeth on a HCR gear the heat treatment and profile modifications that are required for good performance are distinctly different from those for a standard contact ratio gear. The load capacity rating of HCR gears requires the application of modified AGMA analyses as the AGMA Standards specifically do NOT address gears with profile contact ratios greater than 2.0 thus we will also cover the changes required to successfully rate HCR gears.

LEARNING OBJECTIVES

- ▷ Identify what an HCR gear is and understand when to use them.
- ▷ Recognize the detailed tooth geometry requirements to achieve optimum gear performance.
- ▷ Classify the changes required to successfully rate HCR gearsDraw upon the relationship between standard rating practices and actual bevel gear tooth stresses as a means of optimum design.

TAMING TOOTH DEFLECTIONS

3 Clock Hours
March 26, 2026

LIVE Online



Instructors: Raymond J. Drago, P.E.

Member Fee \$375 | Non-Member Fee \$475

Tooth deflections under load can cause involute interference which leads to very high tooth surface loads in regions of high sliding and low tooth curvature radius. These conditions loads can produce scoring, spalling and wear failures. Proper profile modifications applied to both members of the mesh eliminate the deleterious effects of the deflection induced involute interference and allow the gear set to yield its maximum inherent load carrying capacity. Proper profile modifications also allow a gear set to operate with lower noise and vibration levels.

LEARNING OBJECTIVES

- ▷ Learn how teeth deflect, what involute interference really is, the potential consequences of inadequate profile modifications, and the differences between tip relief, flank relief and fully modified profiles.
- ▷ Calculate tooth deflections under load and, most especially, how to modify a gear set properly to completely eliminate involute interference.
- ▷ Examine the optimum drawing definitions for profile modifications and how to interpret involute inspection charts to determine if the drawing required profile modifications have actually been produced on the gear set.

ADVANCED CONCEPTS OF BEARING TECHNOLOGY

32 Clock Hours
May 18-21, 2026

Schaumburg, IL



Instructors: Daniel Snyder, Timothy Ovaert, Vern Wedeven, and Brian Werner

Member Fee \$2,650 | Non-Member Fee \$2,950

This course builds on the foundations of the essential course and challenges the experienced engineer in areas such as failure modes, friction and wear, fatigue life calculation methods and load distribution. This is an exceptional course for engineers with two to three years work experience in bearings or past attendees of the Essential Concepts of Bearing Technology.

LEARNING OBJECTIVES

- ▷ Bearing macrogeometry: osculation, internal clearances, contact angles.
- ▷ Load contacts, ball/roller loading: static/inertial.
- ▷ Contact stresses, deflection, surface & subsurface stresses.
- ▷ Internal load distribution – loaded zones, speed & motion.
- ▷ Concepts of friction & wear: surface topography and measurement.
- ▷ Fundamentals of fatigue life theory, dynamic capacity.
- ▷ Contact friction, traction effects.
- ▷ Bearing friction & iso reference speed ratings.
- ▷ Permanent deformations & static capacity.
- ▷ Fatigue life prediction: standards & advanced calculation methods.
- ▷ Testing methods & statistical test data analysis.
- ▷ Lubricants & rheology & ehl calculations.
- ▷ Shaft-bearing systems & performance analysis.
- ▷ Determining preload.

GEAR FAILURE ANALYSIS

24 Clock Hours
June 9-11, 2026
November 10-12, 2026
Detroit, MI



Instructors: Terrance Klaves and Lance Brown

Member Fee \$2,250 | Non-Member Fee \$2,750

Explore gear failure analysis in this hands-on seminar where students not only see slides of failed gears but can hold and examine over 130 specimens with the same failure modes covered in the seminar. Approximately half of the course time consists of students in groups identifying failure modes on failed gears and working on a case study. Microscopes are available to examine failed specimens.

This course is taught at AGMA National Training Center.

LEARNING OBJECTIVES

- ▷ 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.
- ▷ Diagnose the root causes of failure.
- ▷ Prescribe remedies to prevent repeat failures.
- ▷ Use the GEARTECH textbook and other provided resources for ongoing study of gear failure analysis.
- ▷ Tailor failure analysis techniques for their specific requirements.



INVOLUTE SPLINE DESIGN AND RATING

7 Clock Hours
July 14-15, 2026

LIVE Online



GEARBOX SYSTEMS DESIGN

24 Clock Hours
August 18-27, 2026

LIVE Online

Instructor: Raymond J. Drago, P.E.

Member Fee \$650 | Non-Member Fee \$750

This course will address both geometry and rating of involute splines of various types. The types of spline joints and their applications will be discussed. Spline configuration variations, including half depth, full depth, and special function designs, will be addressed. Both fixed and flexible spline configurations will be examined in terms of usage and design. Lubrication methods, including grease, oil bath, and flowing oil, as well as coatings appropriate for various spline applications, are examined. Shear and compressive stress rating methods are discussed with analyses methodology presented in both equation and graphical methodology via various rating charts.

LEARNING OBJECTIVES

- ▷ Explain involute splines and the various types.
- ▷ Compare and contrast spline configuration variations.
- ▷ Apply various lubrication methods to splines and spline applications.
- ▷ Apply rating methods and analyze methodology.

Instructors: Raymond J. Drago, P.E. and Steve Cymbala

Member Fee \$2,050 | Non-Member Fee \$2,550

This course focuses on the supporting elements of a gearbox that allow gears and bearings to do their jobs most efficiently. Learn about seals, lubrication, lubricants, housings, breathers, and other details that go into designing gearbox systems.

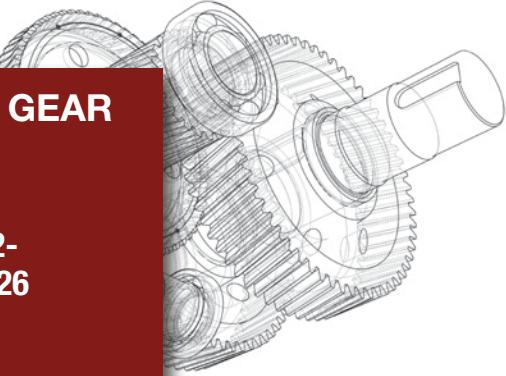
LEARNING OBJECTIVES

- ▷ Understand types of housing construction, housing elements (covers, inspection ports, sump, mounting, etc.).
- ▷ Apply drawing practices for housings and related components.
- ▷ Learn about bearing mounting, retention and sealing.
- ▷ Understand election and role of gearbox accessories, such as breathers, filters, screens, sight gages, and other level indication devices.
- ▷ Apply the appropriate lubricant selection.
- ▷ Apply the lubricant to the rotating elements.
- ▷ Describe the selection criteria concerning the basic lubricant chemistry (since the best design is only as good as its implementation, drawing practices and tolerancing will also be addressed from the designers' perspective).
- ▷ Learn about translating the general design from the design manual to the individual component drawings.

DETAILED GEAR DESIGN

24 Clock Hours
**September 22-
October 1, 2026**

LIVE Online



Instructor: Raymond J. Drago, P.E.

Member Fee \$2,050 | Non-Member Fee \$2,550

There is a distinct difference between designing a gear and optimizing a gear design. In this course, we will address the optimization process via an understanding of those factors beyond basic banding and pitting ratings. Optimization may focus on load capacity, economy of production or minimization of overall gear system envelope. In this course we will learn how to improve gear designs via optimization and gain new insight into concepts presented through illustrations and demonstrations. Explore all factors that go into good gear design from life cycle, load, torque, tooth, optimization, and evaluating consequences.

LEARNING OBJECTIVES

- ▷ Improve gear designs.
- ▷ Apply their understanding of gear rating theory and analysis methods.
- ▷ Investigate differences in stress states among various surface durability failure modes.
- ▷ Discuss time dependent and time independent failure modes related to tooth design.
- ▷ Use computer generated graphics to examine mesh action and tooth interaction.
- ▷ Discuss the concepts presented.

GEAR MATERIALS

24 Clock Hours
October 20-22, 2026

Wilmington, DE



Instructors: Raymond J. Drago, P.E. and Dale Weires

Member Fee \$2,250 | Non-Member Fee \$2,750

Learn what is required for the design of an optimum gear set and the importance of the coordinated effort of the gear design engineer, the gear metallurgist, and the bearing system engineer. Investigate gear-related problems, failures and improved processing procedures.

LEARNING OBJECTIVES

- ▷ Improve their gear designs.
- ▷ Apply their understanding of gear rating theory and analysis methods.
- ▷ Investigate differences in stress states among various surface durability failure modes.
- ▷ Discuss time dependent and time independent failure modes related to tooth design.
- ▷ Use computer generated graphics to examine mesh action and tooth interaction.
- ▷ Discuss the concepts presented.

LUBRICATION AND WEAR: ADVANCED CONCEPTS

21 Clock Hours
October 20-22, 2026

Wilmington, DE



Instructors: Tim Ovaert and Vern Wedeven

Member Fee \$2,100 | Non-Member Fee \$2,300

Designed for engineers and scientists in the rolling element bearing, gear, and power transmission industries who desire a more fundamental knowledge of component-relevant topics in the lubrication and wear areas within the field of tribology. The science behind lubrication and wear continues to evolve. This course introduces attendees to important terminology; surface topography measurement, characterization, and application; the mechanics of surfaces in contact; the development of lubricant films; and failure of rolling element bearings. The purpose of this course is to increase relevant technical knowledge and bridge the gap between component design and component failure, as a result of relative motion between surfaces in contact.

LEARNING OBJECTIVES

- ▷ Understand basic concepts and terminology in tribology.
- ▷ Familiarity with surface characterization theory and methods.
- ▷ Calculation of fluid-film lubrication parameters.
- ▷ Introduction to tribology by design (TBD) methods.
- ▷ Understanding bearing life and failure through theory and examples.

REVERSE ENGINEERING

8 Clock Hours
November 4-5, 2026

LIVE Online

Instructor: Raymond J. Drago, P.E.

Member Fee \$650 | Non-Member Fee \$750

We will discuss the basic types of reverse engineering projects. The need for understanding the operation of the system in which the gears will be used, the conditions that led to the need for the project and especially, the specific nature of the failure that occurred, if that is the reason for the project, are key, often ignored, elements of the process. In some cases, no drawings are available at all; thus, a design must be developed that will yield gears that provide equivalent load capacity, life, noise performance and smoothness of operation. This scenario will be discussed with recommended analyses resented. In other cases, where no drawings are available, the correct procedures to follow in developing a reverse engineered gear that truly meets the system requirements will be discussed in detail with cautionary procedures outlined.

LEARNING OBJECTIVES

- ▷ Understand the difference between designing from scratch and designing to duplicate an existing part and its function.
- ▷ Consider the reasons why reverse engineering an existing gear set, or, especially, a single gear can often be considerably more difficult than designing a new gear or gear set from scratch.
- ▷ Discuss the possibilities for misunderstanding, which are legion, between purchaser and supplier.
- ▷ Apply an understanding of forensic analysis of gearbox failures to avoid simply duplicating the original failure.
- ▷ Understand the difference between a temporary replacement and a duplicate of the original gear.

2026 Calendar of Events

Learn from industry experts. Network with your peers.

2/3/2026-2/12/2026 GEARBOX CSI Online	5/19/2026-5/21/2026 EV AUTOMOTIVE TRANSMISSION SYSTEM DESIGN Schaumburg, IL	8/4/2026-8/6/2026 ESSENTIAL CONCEPTS OF BEARING TECHNOLOGY Charlotte, NC
2/24/26 ANALYTICAL GEAR CHART INTERPRETATION Online	6/2/2026-6/4/2026 FUNDAMENTALS OF GEAR DESIGN AND ANALYSIS Clearwater Beach, FL	8/18/2026-8/27/2026 GEARBOX SYSTEMS DESIGN Online
2/25/26 DESIGN BASICS OF SPUR AND HELICAL GEARS Online	6/2/2026-6/4/2026 STRATEGIC NETWORKING AND LEADERSHIP FORUM Indianapolis, IN	9/1/2026-9/2/2026 HOW TO READ AND INTERPRET A GEAR INSPECTION REPORT Online
2/26/26 BASIC LOADED TOOTH CONTACT ANALYSIS THEORY Online	6/9/2026-6/11/2026 GEAR FAILURE ANALYSIS Detroit, MI	9/22/2026-10/1/2026 DETAILED GEAR DESIGN Online
3/2/2026-3/6/2026 BEVEL GEAR SYSTEMS DESIGN Online	6/23/26 ANALYTICAL GEAR CHART INTERPRETATION Online	9/28/2026-10/2/2026 BASIC TRAINING FOR GEAR MANUFACTURING Chicago, IL
3/24/26 HIGH PROFILE CONTACT RATIO GEARING Online	7/13/26 DESIGN BASICS OF SPUR AND HELICAL GEARS Online	10/5/2026-10/7/2026 FALL TECHNICAL MEETING Rosemont, IL
3/26/26 TAMING TOOTH DEFLECTIONS Online	7/14/2026-7/15/2026 INVOLUTE SPLINE DESIGN AND RATING Online	10/20/2026-10/22/2026 GEAR MATERIALS Wilmington, DE
4/13/2026-4/17/2026 BASIC TRAINING FOR GEAR MANUFACTURING Chicago, IL	7/16/26 BASIC LOADED TOOTH CONTACT ANALYSIS THEORY Online	10/20/2026-10/22/2026 LUBRICATION AND WEAR Wilmington, DE
4/23/2026-4/25/2026 MPMA ANNUAL MEETING Charlotte Harbor, FL	7/21/2026-7/22/2026 OPERATOR GEAR GRINDING Online	11/2/2026-11/3/2026 DESIGN AND PERFORMANCE RATING PROCEDURES FOR PLASTIC GEARS Online
5/18/2026-5/21/2026 ADVANCED CONCEPTS OF BEARING TECHNOLOGY Schaumburg, IL	8/4/2026-8/6/2026 FUNDAMENTALS OF WORM AND CROSSED AXIAL HELICAL GEARING Charlotte, NC	11/4/2026-11/5/2026 REVERSE ENGINEERING Online
		11/10/2026-11/12/2026 GEAR FAILURE ANALYSIS Detroit, MI

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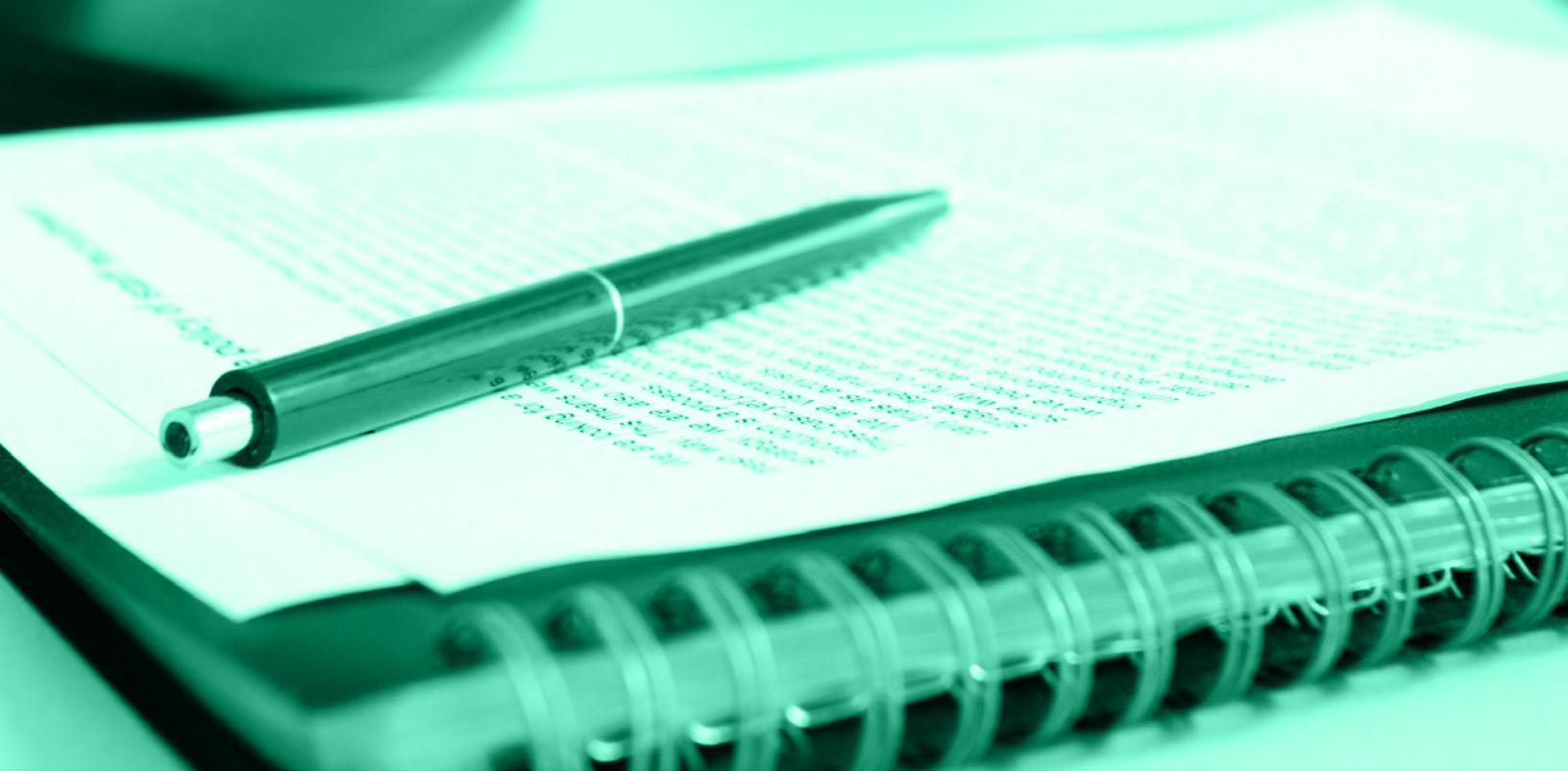
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