THE INTERNATIONAL ACCREDITORS FOR CONTINUING EDUCATION AND TRAINING

American Gear Manufacturers Association (AGMA) is accredited by the International Accreditors for Continuing Education and Training (IACET) and offers IACET CEUs for its learning events that comply with the ANSI/IACET Continuing Education and Training Standard. IACET is recognized internationally as a standard development organization and accrediting body that promotes quality of continuing education and training.

AGMA was originally approved and began active status in December 2017. A renewal occurs every 5 years to ensure compliance with the ANSI/IACET Standards. AGMA went through reaccreditation in 2022 and have been reaccredited through November 2027.

CONTINUING EDUCATION UNITS

As an IACET Accredited Provider, AGMA offers continuing education units (CEUs) for its programs that qualify under the ANSI/IACET Standard. One CEU is equal to 10 hours of instruction, not including breaks or lunch. The learning activities allowed to receive CEU awards are face-to-face classes, distance courses, competency-based courses, and other learning events that meet the IACET/ANSI Standards. Partial credit or adjusted CEUs will not be awarded for individuals who do not successfully meet the criteria for achievement of CEUs.

LEARNER SUPPORT

Need detailed information on courses? Have a question about the certificate program requirements?

We are here to provide learner support services to assist you in achieving your professional development goals and objectives. Please contact us at education@agma.org to discuss your educational needs.

For more information on IACET Standard Requirements

CHECK OUT our individual course pages
The AGMA Education Department conducts programs that support the professional development of the gear 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 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

AGMA 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@agma.org.

AGMA Certificate Programs

A leader in gear education, AGMA continues to expand our course offerings to meet the needs of the gear industry. 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 GEAR ENGINEERING CERTIFICATE
For International Industry Professionals (outside of North America)
▷ Three (3) Online Video Training Courses:
  – Detailed Gear Design
  – Gearbox CSI: Gears Only
  – Gear Failure Analysis
▷ Two (2) Additional Advanced Courses of your Choice
  – Face-to-Face or Live, Instructor-Led Virtual Formats

More than 3,000 individuals have completed courses through the AGMA 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.
The development of AGMA’s Workforce Education Series, Operator Level Courses, Online Video Training Courses—Detailed Gear Design, Gear Failure Analysis, and Gearbox CSI—and the 2017 Webinar series are made possible through the generous support of the AGMA 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.

AGMA has built a strong partnership with Richard J. Daley College, one of the City Colleges of Chicago. The AGMA National Training Center (NTC) is located on this campus and provides top-notch training from basic gear manufacturing to advanced engineering courses. Our partnership affords Daley students exposure to gear manufacturing and AGMA students exposure to Daley’s resources.

The 10,000 square foot NTC trains over 600 students per year. Housing machine tools for cutting and inspection, as well as the library of gear failure examples, the NTC provides the unique ability for students to have hands-on experiences in gear manufacturing.

Additionally, the NTC is used to host a variety of other meetings for AGMA and its members, as well as serving as a place for AGMA to host job fairs for its local companies.
AGMA can train your employees at your facility! We understand that training can be costly to your bottom line but it still remains a necessary component for your company to remain on the cutting edge of gear knowledge in order implement best practices in your workplace.

**BENEFITS OF ON-SITE TRAINING**

**Cost savings**
Again, you are cost-conscious – so are we! By bringing an AGMA course to your location, you can eliminate the cost of sending your staff to another location. Your organization will:
- Eliminate travel costs
- Maximize employee training time
- Increase the productivity of your most valuable asset
- Boost your employee retention program
- Reduce turnover

**Convenience**
- Choose the best time to learn based on your employees' workloads and schedules
- Benefit from courses that fit your needs
- Train in your facility or shop

**Relevance**
- Tailor the courses to incorporate examples and content specific to your company's needs and challenges.

**Succession Planning**
- Reduce the impact of the knowledge gap as new hires start and seasoned workers retire
- Increase cross-training activities to enhance and diversify the skills of your workforce

**Privacy**
Having training at your own facility keeps your training needs and proprietary interests private. This allows your team to speak as freely as needed.

**Accredited**
AGMA is accredited by the International Accreditors for Continuing Education and Training (IACET). AGMA complies with the ANSI/IACET Standard, which is recognized internationally as a standard of excellence in instructional practices. As a result of this accreditation, AGMA is accredited to issue the IACET CEU.

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**Ready to bring industry-leading gear education to your workplace?**

**CONTACT US TODAY**
+1 703.684.0211
Education@agma.org

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**SCHEDULING YOUR ON-SITE TRAINING**

1. Choose the course(s)
2. Request a quote by emailing education@agma.org
3. Schedule your training
4. Participate in a planning call
5. Prepare for Training Day
ONLINE ON-DEMAND VIDEO TRAINING COURSES

DETAILED GEAR DESIGN: BEYOND SIMPLE FACTORS
MEMBER FEE: $1,095 | NON-MEMBER FEE: $1,595
Learn about gear design and examine carefully crafted “problems” that will demonstrate the practical application of the optimization methods presented in this seminar. Facilitator: Raymond Drago, P.E. of Drive Systems Technology, Inc.

GEAR FAILURE ANALYSIS
MEMBER FEE: $995 | NON-MEMBER FEE: $1,495
Learn the causes of gear failure and how to prevent it from occurring. You will also examine the various types of gear failure, such as overload, bending fatigue, Hertzian fatigue, wear, scuffing and cracking. Possible causes of these failures will be presented, along with some suggested ways to avoid them. Facilitator: Robert Errichello, P.E., of GEARTECH

GEARBOX CSI: GEARS ONLY
MEMBER FEE: $795 | NON-MEMBER FEE: $1,295
This is webinar focuses on the gear part of the Forensic Analysis of Bearings and Gear course. It helps gear designers gain a better understanding of various types of gears. Learn about properly applying the best gear-bearing combination to any gearbox, simple or complex.

BASICS OF GEARING
MEMBER FEE: $795 | NON-MEMBER FEE: $995
This course provides a solid and fundamental understanding of gear geometry, types and arrangements, and design principles. Basic gear system design process and gear measurement and inspection techniques will also be explained. In addition, the design process to generate a gear pair, design refinement and manufacturing considerations, and interpretation of gear measurement results will be discussed.

WORKFORCE TRAINING SERIES
FREE FOR AGMA MEMBERS | NON-MEMBER FEE: $395/COURSE
This series provides a comprehensive overview of gearing to enhance students’ understanding of essential terminology and practices within the industry.

FUNDAMENTALS OF GEARING
PARALLEL GEAR INSPECTION
HOBING

ARCHIVED WEBINARS
FREE FOR AGMA MEMBERS | NON-MEMBER FEE: $159/COURSE

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

FOR PREVIOUSLY RECORDED WEBINARS
All sessions are recorded and sessions and handouts are available as on demand downloads.

For more information on AGMA’s ON-DEMAND opportunities
VISIT agma.org
LIVE Online

Receive instruction in real-time and get those burning questions answered. Class sizes are limited to enable as much conversation and instructor/student interaction as possible.

**ANALYTICAL GEAR CHART INTERPRETATION**
0.3 CEUs
January 19, 2023
June 29, 2023
LIVE Online

**LOADED TOOTH CONTACT ANALYSIS**
0.3 CEUs
March 7, 2023
LIVE Online

**DESIGN BASICS OF SPUR AND HELICAL GEARS**
0.3 CEUs
June 27, 2023
September 12, 2023
LIVE Online

**MEMBER FEE $325 | NON-MEMBER FEE $425**

**HOW TO READ AND INTERPRET A GEAR INSPECTION CHART**
0.3 CEUs
November 2, 2023
LIVE Online

**MEMBER FEE $550 | NON-MEMBER FEE $650**

**INVOlUTE SPLINE DESIGN AND RATING**
0.6 CEUs
January 24-25, 2023
LIVE Online

**REVERSE ENGINEERING**
0.6 CEUs
April 25-26, 2023
LIVE Online

* NEW CLASSES ARE ADDED PERIODICALLY, SO BE SURE TO CHECK BACK! *

AGMA|ABMA

Annual Meeting 2023
March 16-18, 2023

Disney's Grand Floridian Resort & Spa
LAKE BUENA VISTA, FLORIDA

OPERATOR LEVEL
Course Offerings

OPERATOR
PRECISION GEAR GRINDING

0.6 CEUs
July 25-26, 2023
LIVE Online

Instructor: Terrance Klaves

**MEMBER FEE $550 | NON-MEMBER FEE $650**

Explore precision gear grinding processes, machine input variables, kinematics, machine alignment, setup errors, pitfalls, common gear fatigue failures and expectations related to finish ground gearing. 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 for 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

BASIC GEAR INSPECTION FOR OPERATORS

1.3 CEUs
August 23-24, 2023
Chicago, IL - AGMA National Training Center

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

**FIRST MEMBER FEE $1,095; ADDITIONAL MEMBERS $895 | FIRST NON-MEMBER FEE $1,595; ADDITIONAL NON-MEMBERS $1,395**

This course will provide a solid foundation for anyone going into gear inspection. Learn the common, current and basics of the tools and techniques used to measure and inspect gears. Understand the four main categories by which a gear is evaluated and classified. Gain proficiency in understanding gear quality by learning the numerical scale on which gear design, manufacture and inspection are based, and more.

This course is taught at AGMA National Training Center. A shuttle bus is available each day to transport students to and from the hotel.

**LEARNING OBJECTIVES**
- Describe the differences between measurement and inspection
- Thorough review of measurement techniques
- Thorough review of inspection results
- Use means and methods to interpret and use the outcomes of both measurements and inspection to guide better gear production
- Describe of manufacturing and process cause and effect as defined by the results of gear inspection
- Explain the correlation between manual measurement techniques and how automated GMM (Gear Measurement Machine systems) perform the same task
- Be able to explain the automated processes used by GMM systems to assess gear quality
- Review of applicable standards
OPERATOR
HOBBLING & SHAPER CUTTING

1.3 CEUs
October 4-5, 2023
Chicago, IL - AGMA National Training Center

Instructor: Peter Grossi

FIRST MEMBER FEE $1,095; ADDITIONAL MEMBERS $895 | FIRST NON-MEMBER FEE $1,595; ADDITIONAL NON-MEMBERS $1,395

Learn and understand fundamentals of gear manufacturing. Acquire knowledge and understanding of gear nomenclature, hobbing and shaping of spur and helical gears, and splines. Learn and understand hobber and shaper machine set-up, as well as gear tooth element inspection. Understand the manufacturing process before gear tooth cutting, as well as post cutting processes. Apply concepts to further finishing processes (i.e. heat treat, skiving, and gear tooth shaving and grinding). Gain knowledge to establish a solid foundation for all basic gear manufacturing.

This course is taught at AGMA National Training Center. A shuttle bus is available each day to transport students to and from the hotel.

LEARNING OBJECTIVES
▷ Identify gear blank inaccuracies
▷ Establish proper machine set-up procedures and practices
▷ Define gear tooth element nomenclature
▷ Identify gear tooth errors resulting from hobber and shaper machine set-up errors, as well as cutter sharpening errors
▷ Interpret gear inspection charts for quality level

SAVE THE DATES

MOTION + POWER TECHNOLOGY EXPO

October 17-19, 2023
Huntington Place • Detroit, MI (formerly the TCF Center and Cobo)

This event is co-located with the Motion + Power Technology Expo Fall Technical Meeting

October 16-19, 2023
Huntington Place • Detroit, MI (formerly the TCF Center and Cobo)

Abstract Submission Deadline for the 2023 FTM is January 13, 2023.
Evaluation of loaded tooth contact and development of tooth modifications using commercially available software to improve KHB 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
Instructors: Dwight Smith, Allen Bird and Peter Grossi

**FUNDAMENTALS OF GEAR DESIGN AND ANALYSIS**

2.0 CEUs  
**June 6-8, 2023**  
Rosemont, IL

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

**FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350**

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 inter-relation 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. Learn the steps and issues involved in design refinement and some manufacturing considerations. 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.

**LEARNING OBJECTIVES**

▷ Develop a full appreciation for the meaning and correct use of gear nomenclature  
▷ Appreciate and be able to correctly select the basic gear train arrangements as a function of application  
▷ Be able to describe and discuss the external factors that effect a gear pair and/or a gear train  
▷ Describe how the applied torque manifests itself as a force on the surface of the tooth and further how this develops into stress within the body of the tooth  
▷ Be able to describe and discuss the various common manufacturing techniques for gears  
▷ Describe the measurement and inspection techniques used to qualify a gear

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**BASIC TRAINING FOR GEAR MANUFACTURING**

2.7 CEUs  
**April 17-21, 2023**  
**September 18-22, 2023**  
Chicago, IL - AGMA National Training Center

Instructors: Dwight Smith, Allen Bird and Peter Grossi

**FIRST MEMBER FEE $1,795; ADDITIONAL MEMBERS $1,595 | FIRST NON-MEMBER FEE $2,295; ADDITIONAL NON-MEMBERS $2,095**

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. A shuttle bus is available each day to transport students to and from the hotel.*

**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

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REAL WORLD EDUCATION. REAL WORLD APPLICATION.
Design Basics of Spur and Helical Gears

0.3 CEUs
June 27, 2023
September 12, 2023
LIVE Online

Instructor: Terrance Klaves

MEMBER FEE $325  |  NON-MEMBER FEE $425

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 on 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, i.e. 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

How to Read and Interpret a Gear Inspection Chart

0.3 CEUs
November 2, 2023
LIVE Online

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

MEMBER FEE $325  |  NON-MEMBER FEE $425

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
1) INVLUTE SPLINE DESIGN AND RATING
0.6 CEUs

January 24-25, 2023
LIVE Online

Instructor: Raymond J. Drago, P.E.

MEMBER FEE $550 | NON-MEMBER FEE $650

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

2) BEVEL GEAR SYSTEMS DESIGN
2.0 CEUs
February 7-16, 2023
LIVE Online

Instructor: Raymond J. Drago, P.E.

FIRST MEMBER FEE $1,850; ADDITIONAL MEMBERS $1,650 | FIRST NON-MEMBER FEE $2,350; ADDITIONAL NON-MEMBERS $2,150

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

SNL Forum
Strategic Networking & Leadership Forum
May 17-19, 2023
Fort Worth, TX

ADVANCED LEVEL
Course Offerings
GEARBOX CSI
2.0 CEUs
February 28 - March 2, 2023
Philadelphia, PA


FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350

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/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 and we will also discuss and describe various actual failure scenarios. In addition, a detailed primer on bearing technology prefaces 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

EPICYCLIC GEAR SYSTEMS
2.0 CEUs
March 28-30, 2023
St. Petersburg, FL

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

FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350

Learn and define the concept of epicyclic gearing including some basic history and the differences among simple planetary gear systems, compound planetary gear systems and star drive gear systems. Cover concepts on the arrangement of the individual components including the carrier, sun, planet, ring and star gears and the rigid requirements for the system to perform properly. Critical factors such as load sharing among the planet or star gears, sequential loading, equal planet and star spacing, relations among the numbers of teeth on each element, calculation of the maximum and optimum number of planet and star gears for a specific system will be covered. This course will provide an in-depth discussion of the methodology by which noise and vibration may be optimized for such systems and load sharing guidelines for planet load sharing.

LEARNING OBJECTIVES
▷ Restate exactly what makes a gear system an epicyclic system
▷ Calculate the total reduction ratio of epicyclic and star systems
▷ Identify differences and similarities between split power systems and true epicyclic systems
▷ Explain the importance of equal planet and star gear spacing and how a system can be designed with unequal planet spacing
▷ Interpret how the numbers of teeth selected for the individual gears in an epicyclic or star drive gear system affect the noise and vibration characteristics of the system
▷ Evaluate the numbers of teeth on the sun, planet, and internal ring gear (not arbitrary)
▷ Explain how the design of the carrier affects the overall performance of these complex systems
▷ Determine how the input speed affects the design of an epicyclic system and why the speed concerns are different for epicyclic and star drive systems
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
GEAR FAILURE ANALYSIS

2.0 CEUs

May 16-18, 2023
November 14-16, 2023

Chicago, IL - AGMA National Training Center

Instructor: Andrew Milburn

FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350

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. A shuttle bus is available each day to transport students to and from the hotel."

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

GEARBOX SYSTEMS DESIGN

2.0 CEUs

June 20-22, 2023

Clearwater Beach, FL

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

FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350

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.
Instructor: Raymond J. Drago, P.E.

**DETAILED GEAR DESIGN**

2.0 CEUs

**July 11-13, 2023**

Alexandria, VA

**FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350**

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

Instructors: Patrik Olund & Hans-Willi Raedt

**STEELS FOR GEAR APPLICATIONS**

2.0 CEUs

**August 8-10, 2023**

Oak Brook, IL

**FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350**

Gain a basic understanding of steel and its properties. Learn to make use of steel properties in an application and understand the potential that different steel and heat treatment options can offer. Explore how performance of the material depends on how the steel is produced.

**LEARNING OBJECTIVES**

▷ Describe how material properties affect by steel quality and heat treatment
▷ Describe how stresses are introduced by heat treatment process and surface modification treatments
▷ Explain how to select a steel and heat treatment combination to meet the demands of the application
▷ Review influence of material selection on the manufacturing of components
▷ Discuss how to verify and specify required steel properties
GEAR SYSTEMS
DESIGN FOR
MINIMUM NOISE

2.0 CEUs
December 5-7, 2023
San Diego, CA

Instructor: Raymond J. Drago, P.E.

FIRST MEMBER FEE $2,050; ADDITIONAL MEMBERS $1,850 | FIRST NON-MEMBER FEE $2,550; ADDITIONAL NON-MEMBERS $2,350

The general nature of noise and its measurement will be examined, with particular emphasis on terminology standards, and units of measurement appropriate to gear technology. The mechanism by which observer noticed noise is generated and transmitted will be defined, described, discussed. Before attempting to solve a noise problem with an existing unit or beginning the design of a new unit, the nature of the noise must be defined. Both experimental and analytical methods will be covered, with particular emphasis on application rather than theory. The factors that influence the noise produced by a gear system and the effects of each will be discussed. Various techniques that can reduce the noise level of existing gear systems without requiring major hardware replacement will be presented and discussed.

LEARNING OBJECTIVES
▷ Understand the need for gearbox system noise control
▷ Become familiar with the nature of noise and its measurement as well as terminology standards, and units of measurement appropriate to gear technology
▷ Learn the mechanisms by which observer noticed noise is generated and transmitted
▷ Explain the importance of equal planet/star gear spacing and how a system can be designed with unequal planet spacing
▷ Understand the various design and manufacturing factors that influence gear system noise

FUNDAMENTALS OF WORM AND CROSSED AXIS HELICAL GEARING

1.7 CEUs
December 5-7, 2023
San Diego, CA

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

FIRST MEMBER FEE $1,695; ADDITIONAL MEMBERS $1,495 | FIRST NON-MEMBER FEE $2,195; ADDITIONAL NON-MEMBERS $1,995

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
ADVANCED CONCEPTS OF BEARING TECHNOLOGY
June 5-8, 2023
Rosemont, IL

Instructors: Daniel Snyder, Timothy Ovaert, and Brian Werner

MEMBER FEE $2,350 | NON-MEMBER FEE $2,650

This course builds on the foundations of the essential course and challenges the experienced engineer in areas such as failure modes, friction & wear, fatigue life calculation methods and load distribution. This is an exceptional course for engineers with 2-3 years work experience in bearings or past attendees of the Essential Concepts of Bearing Technology.

LEARNING OBJECTIVES
▷ Contact Stresses, Deflection, Surface & Subsurface Stresses
▷ Internal Load Distribution – Speed & Motion
▷ Concepts of Friction & Wear: Surface Topography
▷ Permanent Deformations & Static Capacity
▷ Fatigue Life Prediction: Standards & Advanced Calculations
▷ Testing Methods & Statistical Test Data Analysis
▷ Lubricants & Rheology & EHL Calculations

ESSENTIAL CONCEPTS OF BEARING TECHNOLOGY
August 8-10, 2023
Oak Brook, IL

Instructors: Daniel Snyder, Timothy Ovaert, and Vern Wedeven

MEMBER FEE $2,250 | NON-MEMBER FEE $2,550

“This course will give you an overview of the bearing industry as well as basic bearing types and applications. Knowledge of the key players, bearing types and terminology will ensure that everyone has a basic knowledge of the industry upon arrival. This course is specially designed for engineers and others with technical backgrounds that have limited exposure to 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 tribology, bearing attributes and applications and explores the basic concepts around manufacturing methods, loads, lubrication and failure.”

LEARNING OBJECTIVES
▷ Rolling Bearing Types, Attributes, Typical Applications,
▷ Macrogometry & Industry Standards
▷ Bearing Loads & Applications: Static and Dynamic
▷ Contact Stresses – Surface & Subsurface
▷ Materials and Lubricants
▷ Failure Modes in Rolling Bearings
▷ Bearing Life Standards & Calculation Methods

Founded in 1917, the American Bearing Manufacturers Association (ABMA) has long and rich history, which includes aiding in the production of bearings in World War I and fighting counterfeit bearings around the world. ABMA provides leadership, advocacy and education on issues impacting the global bearing industry. ABMA’s members include manufacturers of bearings and finished components as well as suppliers to the bearing industry. Participants from member companies are CEOs and senior executives—the key decision-makers and the most successful and forward thinking leaders in the bearing industry. Engage with ABMA to gain access to membership opportunities, receive updates on industry news, attend courses, or become a key partner.

Check out the website!
https://www.americanbearings.org/page/educationcourses

ABMA members get AMBA member pricing on classes

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American Bearing Manufacturers Association

AGMA members get AGMA member pricing on classes