220: Bevel Gear Systems Design-
A Practical Guide for the Design Engineer

INSTRUCTOR Information
Raymond J. Drago
Email: geardoctor@verizon.net

COURSE INFORMATION

Course Description
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.

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

Course Rationale/Students Course Designed to Serve
Engineers, technicians, and others involved in the selection, application and/or design of bevel gear systems.

Learning Outcomes
- 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

Required Textbooks (Provided by MPMA)
Bevel Gear System Design: Manufacture, Heat Treatment, Inspection and Application by Raymond J. Drago, PE

COURSE OUTLINE

I. History of bevel gears to provide an understanding on the development and application of these gear systems in real world situations.

II. Basic knowledge of the manufacturing processes commonly employed in the production of the various bevel gears.

III. A discussion of the overall gearbox system and designing gears not as individuals but as parts of a whole.

IV. A detailed discussion of the proper preparation of drawings for bevel gears will be presented. The discussion will include sample drawings to fully illustrate basic drawing requirements.

V. The use of manufacturing processes as a design tool, particularly in the area of integral bevel gear design.

VI. A discussion of how to obtain maximum benefit and design impact. This will include instruction on various methods of inspecting bevel gears and interpreting results of the inspection to make better decision in the design and manufacture processes.

VII. Instruction on the benefits and limitations of heat treat processes specific to bevel gear systems will be provided. The importance of designing the gear blank for the heat treatment operation will also be addressed. (as this is a key design element that is often neglected)

VIII. The effect of quenching on the fi al gear geometry and the use of quench dies will be addressed

IX. A discussion of final finishing operations including isotropic finishing and shot peening.

X. Good assembly and installation practices, quality control as applied to the installation and pattern/ backlash checking of the finished gears in the gearbox are discussed with an emphasis on the practical interpretation of the results.

XI. In depth discussion on how to adjust the gears at assembly to achieve the desired result.

XII. Load capacity rating discussion including basic rating methods typically applied to bevels but also the relation between actual measured tool stresses and the theoretical calculated stresses.

XIII. An overview of proper methods of lubricating bevels and their supporting bearings and the specific lubricants best suited for these applications will be provided.

XIV. An overview of maintenance practices required once the gear systems are in place.

ASSIGNMENTS AND ACTIVITIES

Assignments

Assignments and learning activities are given and directed at the discretion of the instructor.

COURSE MANAGEMENT

Weather Delays and Cancelations
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
Plagiarism[1], 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."