Plastic Gear Fundamentals: Design and Manufacturing

Featuring Speakers From:
Ohio State University
Ticona Engineering Polymers
UFE Incorporated
Universal Technical Systems, Inc.

October 17–18, 2006
Holiday Inn Select—O’Hare Airport, Rosemont, IL

OSU, Ticona Engineering Polymers, UFE, and UTS have collectively come together to process and share with you our expert knowledge in plastic gearing.
We started with the goal of creating the world’s best introductory course in plastic gearing. We think we have succeeded and are now presenting two days of immersion in all aspects of plastic gearing based on:

- Academic and test expertise of Ohio State University’s Gear Lab
- Engineering plastics material expertise of Ticona
- Plastic Gear tooling and parts manufacturing expertise of UFE and
- Plastic and metal gear design and manufacturing software expertise of UTS

Each segment of the seminar will include a lively discussion of case studies—some of them based on questions submitted in advance by the attendees. At the end of the seminar everyone will have gained a wealth of practical experience regarding plastic gearing.

The introductory segment of the seminar establishes the key issues involved in plastic gearing and then reviews how the two days are organized.

**Introduction**
(Andrew Ulrich, UFE, Inc. and Dr. Donald Houser, Ohio State University)

Covers an introduction to gearing fundamentals, addressing topics such as:
- Applications of plastic gearing
- Gear failures
- Basic parallel axis gear geometry—spur and helical gears
- Operating parameters—geometric and environmental
- Manufacturing considerations including gear inspection
- Effect of manufacturing errors on load distribution and stresses

Some discussions will also be presented on other gear types such as bevel, spiral bevel, crossed axis helical/worm, and face gears

**Materials**
(Dr. Zan Smith, Ticona Engineering Polymers)

A discussion of materials used in plastic gears
- This section deals with plastic fundamentals such as basic plastic materials, material properties, do’s and don’ts involved in designing plastic parts.
- Special emphasis is placed on material properties that uniquely impact plastic gearing applications

We will be addressing questions such as:
- Why do I need to understand plastic materials?
- Do material data sheets present enough information? If not, what additional information should you look for?
- How do part design and production aspects affect material properties?
- What plastic materials are typically used for gear design?

**Design**
(Jim Marsh, Universal Technical Systems, Inc.)

Gear mesh design process
In addition to the steps you need to go through while designing metal gears, when it comes to plastic gears, one has to worry about other factors such as effects of temperature, humidity, part shrinkage during molding, etc.

To give you a good feel for the design process, a typical gear mesh will be designed, with your input, in a step by step manner.

The design process will consist of:
- Preliminary sizing
- Optimization of various design parameters
- Effective center distances at extremes of temperature and other variable factors
- Geometry evaluation at extremes
- Final gear capacity analysis
- Gear tooth profile modifications
- Gear tooth coordinates for manufacturing, etc.

And will address questions such as:
- What is the process for designing a functional plastic gear set?
- How do I know the gears are sized properly?
- How does the mounting tolerances and environment affect the gear mesh?
- How do I calculate and specify the appropriate information to the supplier?

**Noise**
(Dr. Donald Houser, Ohio State University)

A detailed discussion on what contributes to noise in a gear mesh
The need to reduce noise is one of the most common problems plastic gear designers have to deal with. Our goal is not to make you noise experts but we will be addressing issues such as:
- Source—path—receiver models
- Plastic gear noise demo: Example components (toys, drills, mixers, etc.), OSU test rig.
- Frequency spectrum/noise measurement methods
- Typical problems—gear mesh
- Example of noise excitation of plant gears
- How do I calculate and specify the appropriate information to the supplier?

The key question to answer is:
What are the contributing factors to a noisy gear set and what can be done to improve the sound level or sound quality?

**Manufacturing**
(Andrew Ulrich, David Kinne, and Steve Snell, UFE, Inc.)

Definitions, rules of thumb, and examples of plastic gear part design for effective manufacturing
- Defining the rest of the gear after tooth optimization.
- Supporting wall sections
- Proper coring
- Added features
- Gating
- Ejection

Investigation of the consequences part design has on manufacturing/mold design
- Part Features
- Gating
- Cooling
- Melting flow simulation
- Cavity Speciation
- Ejection
- Examples

**Manufacturing/Processing and Inspection**

- Inspection
- Development inspection methods
- Production inspection methods
- Processing Issues
  - How part design affects manufacturing cycle time
  - How material additives can affect cycle times
  - Insert molding pros and cons
  - How requested quality levels (AGMA grade levels) can dictate handling methods and packaging
- Automation and robotics

The questions we propose to answer from a gear manufacturing viewpoint are:
- Gear Part Design: What are good design practices for designing the total gear (beyond the gear mesh) as it relates to gear accuracy?
- Gear Part Design: Gear blank—’the rest of the gear’ and the design effects on manufacturing
- Manufacturing/Mold Design: How do part design decisions affect mold design and what are the ramifications on quality and cost?
- Manufacturing/Mold Design: What limitations exist in mold construction affecting part accuracy?
- Manufacturing/Processing and Inspection: How does part design affect processing and inspection and what are the ramifications on quality and cost?
Plastic Gear Fundamentals: Design and Manufacturing—Presenter Biographies

Dr. Donald Houser
Ohio State University Gear Lab

Professor Emeritus Donald Houser received his BS, MS and PhD degrees from the University of Wisconsin in Madison. He served on the faculty of the Department of Mechanical Engineering at Ohio State for 35 years. Dr. Houser is director of the Gear Dynamics and Gear Noise Research Laboratory (GearLab), an industrial research consortium that currently has 38 participating companies. He has supervised over 110 graduate student theses and has consulted on gearing problems with over 50 companies. Professor Houser has authored over 130 publications, most of them in the area of gearing.

Dr. Zan Smith
Ticona Engineering Polymers

Zan Smith received BS, MME, and Ph.D. degrees in Mechanical Engineering at North Carolina State University. He is an Engineer Associate in the Technical Services Department of Ticona Engineering Polymers, the technical polymers business of Celanese. He was active in editing and writing several of the Ticona design guides and has given seminars and published articles on several aspects of plastic part design. For the last 15 years, he has focused on plastic gear design and data development. He was on the Board of Directors of the American Gear Manufacturers Association (AGMA) for four years and is active in the Plastics Gearing Committee of AGMA. He serves as technical leader on Ticona Engineering Polymers’ Gear Team.

Andrew Ulrich
UFE, Inc.

A Senior Engineer with UFE Incorporated, Stillwater, MN is currently involved with new product design, consultation, specializing in plastic gearing. He has 30 years of experience in the plastic industry. He began his career as a tool and die maker and has progressed through engineering, project management, and tooling CAD/CAM development. He is currently nearly fully committed to gear system design and manufacture. He is an active member of the American Gear Manufacturers Association (AGMA) Plastics Gearing Committee.

Andrew Ulrich
UFE, Inc.

Steve Snell has been with UFE for 22 years, with positions in Production, Molding, Assembly, and management. Mr. Snell, as a Manufacturing Engineer, has been involved with the molding and assembly of gears and gear trains for over 15 years, and has taught internal classes on subjects ranging from materials to safety to assembly techniques. He holds a BS in Mechanical Engineering from the University of Minnesota, 1988.

David Kinde
UFE, Inc.

David Kinde works as a gear mold designer in the UFE Mold Manufacturing Business Unit. He has 15 years experience as a mold maker and mold designer. He also has an A.S. in Engineering Drafting and Design, as well as a B.S. in Industrial Technology/Product Development, from UW–Stout.

Jim Marsch
Universal Technical Systems, Inc.

Jim Marsch became gear software product manager for Universal Technical Systems in October of 2001. Jim has more than 35 years of experience in power train design, project management, materials procurement, and manufacturing systems administration. At Allis–Chalmers, where he worked for 12 years, he designed agricultural tractor power trains, receiving seven patents along the way. At Harnischfeger/Morris Material Handling, where he worked for 22 years, he designed power trains for cranes, working his way from winches and swing reducers to complete product groups, hoists, trolleys, end trucks, and controls. A native of Wisconsin, Mr. Marsch earned a Bachelor of Science Degree in Mechanical Engineering from Valparaiso University in Indiana.

Steve Snell
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Contact Information

Register now for Plastic Gear Fundamentals: Design and Manufacturing at:
http://www.uts.com/PlasticGearSeminar

For more information about this exciting event, contact Universal Technical Systems, Inc. by telephone at 800–435–7887 or +1 815–963–2220, or send email to sales@uts.com

Time and Hotel Information

Seminar times: October 17, 2006—8:30 a.m. – 5:00 p.m. • October 18, 2006—8:30 a.m. – 4:00 p.m.  
Price: $699 per attendee

Location: Holiday Inn Select—OHare: Rosemont, Illinois—10233 West Higgins Road, Rosemont, Illinois 60018  
Telephone: 847–954–8600 • For special seminar room rates, mention code “UTS.”

Added Bonus!  
All attendees will receive, at no charge, the following online course:  
(List Price $299)

Gear University: Fundamentals of Gearing

Register now at http://www.uts.com/PlasticGearSeminar