

# GEAR TECHNOLOGY



MAY/JUNE 2000

*The Journal of Gear Manufacturing*

## ANNUAL DIRECTORY OF GEAR MANUFACTURERS GEAR DESIGN

- DESIGN & TESTING OF LOW-NOISE MARINE GEARS
- PRACTICAL GUIDE TO PLASTIC GEAR DESIGN

Computing Spiral Bevel Gears • Book Review • Literature Mart

## THE GEAR INDUSTRY'S INFORMATION SOURCE





The Right  
Choice

From Gleason Pfauter HURTH...

# POWER FOR THE

**POWER  
CUTTING™**

**POWER  
SHAVING™**

**POWERLUBE  
COATINGS™**





# NEW MILLENNIUM

## Gleason Phoenix® 6-Axis CNC Cutting Machine



## Gleason-HURTH ZS130T CNC Gear Shaving Machine



## Pfauter P60 Horizontal Hobbing Machine



### The power to slash bevel gear production costs...

POWER CUTTING™ combines advanced new tooling, innovative chip removal, and all the performance benefits of the Gleason PHOENIX® machines to do bevel and hypoid gear cutting with five times the surface speed of conventional cutting. Face hobbing and face milling on gears and pinions can even be done without coolant, so chips are dry and easy to recycle, parts are clean, and your work area's dry and safe.

### The power to cut shaving times in half...

A speed gear that's conventionally plunge shaved in 24 seconds can now be POWER SHAVED in just 12 seconds. The new Gleason HURTH ZS130T greatly reduces unproductive "auxiliary" times - while raising machining speeds and feeds to new levels.

### The power to improve finer pitch gear hobbing...

The new Pfauter P 60 Horizontal Hobbing Machine is equipped to make vast improvements in your finer pitch gear hobbing operations. Hob and workpiece speeds are much higher. Very fast gantry load/unload helps reduce unproductive non-cutting times. And POWER LUBE COATINGS™ make wet or dry hobbing with either carbide or HSS a reality.

### Bevel Gear Technology Seminar 2000

Everything you need to know about the latest in bevel gear technology.

Register now for the June seminar at Gleason Headquarters in Rochester, NY.



## The Gleason Works

1000 University Ave., P.O. Box 22970  
Rochester, NY 14607-1282 U.S.A.  
Phone: 716/473-1000 Fax: 716/461-4348  
Web site: [www.gleason.com](http://www.gleason.com)  
E-Mail: [sales@gleason.com](mailto:sales@gleason.com)

CIRCLE 110



STAR EXPRESS HOBS...

# Any HOB. Any Time.

Your tool of choice for material, coating, features, size and delivery options.

**Fast:** 3-week delivery on express hobs for involute gear manufacturing.

**Flexible:** Built to your requirements for size, gash, tooth form and material.

**Gashes:** Number of gashes will be determined by the tooth form data, unless otherwise specified. **Tooth Forms:** All forms, including topping, protuberance, modified pressure angles and non-symmetrical tooth forms can be supplied under the Express program.

**Material:** PM-M4 is our standard steel for hobs. For those tougher applications, optional materials are in stock. **Coating:** TiN, Ti (C,N) and (Ti,Al)N Gold Star Coatings are also available with only a slightly longer lead time.

Star: The Number One Choice for Products and Service.

Starcut Sales, Inc., Subsidiary of Star Cutter Company.

23461 Industrial Park Drive, Farmington Hills, Michigan 48335-2855

Phone 248.474.8200 Fax 248.474.9518

[www.starcutter.com](http://www.starcutter.com)



THE LATEST  
INNOVATION  
IN HOBBING.  
SUPERIOR  
QUALITY, SERVICE  
AND DELIVERY.





# GEAR TECHNOLOGY

MAY/JUNE 2000

The Journal of Gear Manufacturing

## FEATURES



27

### The Design and Testing of a Low-Noise Marine Gear

An overview of the design process from Schelde Gears.....20

### A Practical Guide to Molding Better Plastic Geared Transmissions

An approach for maximizing plastic gear performance.....27

### A Modular Approach to Computing Spiral Bevel Gears and Curvic Couplings

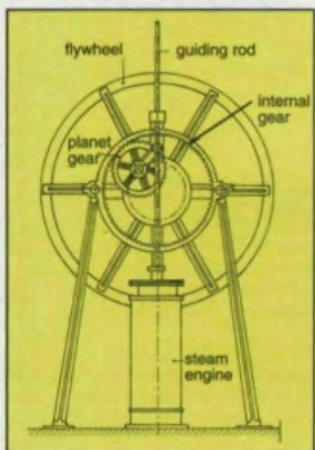
An inside look at the software that drives today's machines.....32

## ANNUAL DIRECTORY OF GEAR MANUFACTURERS

Gear Manufacturing Services Directory.....44

Gear Manufacturing Company Directory.....57

## DEPARTMENTS



72

### Publisher's Page

Management on the High Seas.....7

### Revolutions

Deburring by Drag Finishing, Virtual Prototyping for Multibody Dynamic Systems, The World's Largest Internal Gear Grinder.....11

### Advertiser Index

Check this page for fast and easy ways to contact suppliers.....17

### Industry News

Recent events of note.....19

### Technical Calendar

Make plans now for these upcoming events.....38

### Book Review

Geoffrey Parish's *Carburizing: Microstructures and Properties*, 2nd edition.....40

### Product News

New tools for gear manufacturers.....65

### Literature Mart

Free brochures and catalogs from our advertisers.....68

### Classifieds

Services, Help Wanted and more.....70

### Addendum

The Little Steam Engine that Did.....72



Cover art  
courtesy of  
Crown Gear B.V.,  
Enschede, The  
Netherlands

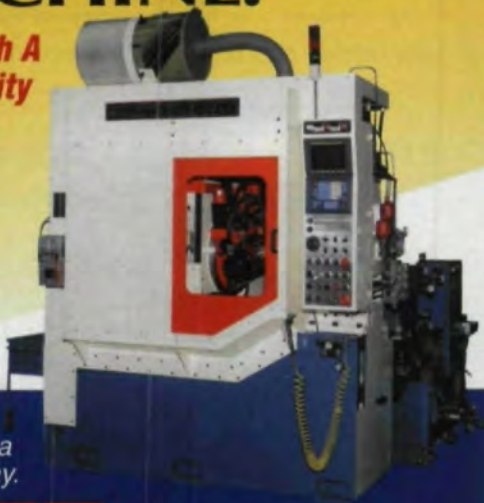


Introducing **JD-150CNC**

# PARKER'S FULL CNC GEAR HOBBING MACHINE.

*Specially Designed With A  
High Degree Of Flexibility  
For Gear Production.*

- Max. Gear Diameter 6"
- Max. Gear Face Width 10"
- Max. Pitch 4 Mod/6DP



For more information and a  
full color brochure call today.

**PARKER** INDUSTRIES INC.

1650 Sycamore Avenue, Bohemia, NY 11716  
1-631-567-1000 • Fax: 1-631-567-1355  
Visit us on the Web at: [www.parkerind.com](http://www.parkerind.com) or E-Mail: [sales@parkerind.com](mailto:sales@parkerind.com)

CIRCLE 149



## BARIT INTERNATIONAL CORPORATION

*Prompt, Personalized Service!*

### Custom Tools

- Hobs .8-50 DP
- Shaper Cutters
- Milling Cutters
- Shaving Cutters
- Broaches

### Stock Items

- DP and MOD
- Hobs, 1DP and finer
- Shaper Cutters



3384 COMMERCIAL AVE. • NORTHBROOK, IL 60062 USA  
TEL: 847-272-8128 • FAX: 847-272-8210  
Website: [www.barit.com](http://www.barit.com) • E-mail: [people@barit.com](mailto:people@barit.com)

CIRCLE 141

## GEAR TECHNOLOGY

The Journal of Gear Manufacturing

### EDITORIAL

Publisher & Editor-in-Chief  
Michael Goldstein

Managing Editor William R. Stott

Senior Editor Charles M. Cooper

Technical Editors  
Robert Errichello  
Don McVittie  
Robert E. Smith  
Dan Thurman

### ART

Art Director Jean Bartz

### ADVERTISING

Advertising Manager Patricia Flam

Advertising Coordinator Susan Brandt

### CIRCULATION

Circulation Coordinator Jennifer Beale

### INTERNET

Internet Editor Daniel Gonsiorowski

Gear Industry Home Page™ Sales  
Patricia Flam

powertransmission.com™ Sales  
Robert Poll

### RANDALL PUBLISHING STAFF

President Michael Goldstein  
Vice President Richard Goldstein  
Controller Patrick Nash  
Accounting Laura Manion  
Art Consultant Marsha Goldstein

Phone: 847-437-6604

E-mail: [people@geartechnology.com](mailto:people@geartechnology.com)

Web: [www.geartechnology.com](http://www.geartechnology.com)  
[www.powertransmission.com](http://www.powertransmission.com)



VOL. 17, NO. 3

GEAR TECHNOLOGY, The Journal of Gear Manufacturing (ISSN 0743-6858) is published bimonthly by Randall Publishing, Inc., 1425 Lunt Avenue, P.O. Box 1426, Elk Grove Village, IL 60007, (847) 437-6604. Cover price \$5.00 U.S. Periodical postage paid at Arlington Heights, IL, and at additional mailing office. Randall Publishing makes every effort to ensure that the processes described in GEAR TECHNOLOGY conform to sound engineering practice. Neither the authors nor the publisher can be held responsible for injuries sustained while following the procedures described. Postmaster: Send address changes to GEAR TECHNOLOGY, The Journal of Gear Manufacturing, 1425 Lunt Avenue, P.O. Box 1426, Elk Grove Village, IL 60007. ©Contents copyrighted by RANDALL PUBLISHING, INC., 2000. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without permission in writing from the publisher. Contents of ads are subject to Publisher's approval.



# Can Anyone Improve Your Bottom Line Like National Broach and Machine?



NBV - Broach Machine



Shavemaster



CNC Hobber



BVT - Broach Machine



SF Gear Grinder

## We have One Great Line of Broaching and Gear Finishing Products

Gear forming and finishing products by National Broach & Machine Co. represent the best in machine tool technology. The advanced software, rigid construction, and efficient design have made it possible for manufacturers to create components of higher quality and greater complexity than ever before. Innovative engineering developments and design simplification showcase NBM's ability to meet the ever-changing needs of industry.

VISIT US AT IMTS 2000  
BOOTH #7048 IN THE  
GEAR GENERATION PAVILLION



Visit Our Website:  
[www.redringproducts.com](http://www.redringproducts.com)

### Broach and Gear Finishing Products

Broaching  
Vertical  
Horizontal  
Pot  
Surface  
Blind Spline  
Vertical Work Transfer  
Broach Sharpening  
Hobbing  
Gear Shaving  
Form Grinding  
Roll Forming  
Roll Finishing  
Gear Inspection  
Honing



 **National Broach & Machine Co.**  
A NACHI Company

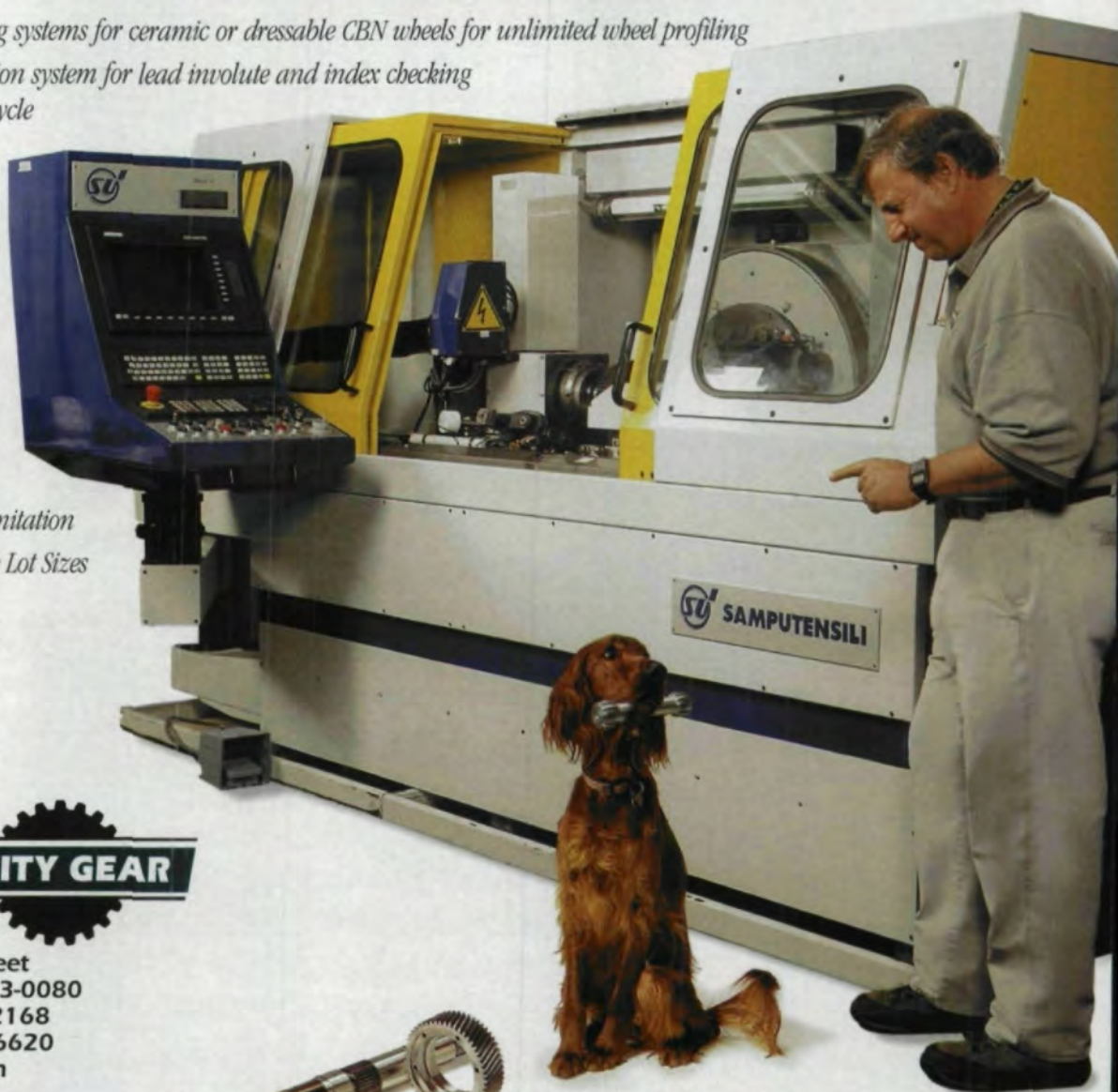
17500 Twenty-Three Mile Road - Macomb, Michigan 48044-1103 810-263-0100 Fax: 810-263-4571



# "You can teach an old dog new tricks!"

## **SAMPUTENSILI RI 370** **Gear and Thread Grinder**

- *Integrated dressing systems for ceramic or dressable CBN wheels for unlimited wheel profiling*
- *Integrated inspection system for lead involute and index checking during the work cycle*
- *Flexibility*
  - External Gears*
  - Internal Gears*
  - Rotors*
  - Worms*
  - Screws*
- *Form Grinding*
- *Unlimited Forms*
- *High Quality and Finish*
- *No Helix Angle Limitation*
- *Prototype or Large Lot Sizes*



### **FOREST CITY GEAR**

P.O. Box 80  
11715 Main Street  
Roscoe, IL 61073-0080  
Ph.: (815) 623-2168  
Fax: (815) 623-6620  
[www.fcgear.com](http://www.fcgear.com)

ISO9002  
Registered



**Fred Young**  
President of  
Forest City Gear



### **SU AMERICA INC.**

8775 Capital Avenue  
Oak Park, MI 48237  
Ph.: (248) 548-7177  
Fax: (248) 548-4443  
E-Mail: [sales@suamerica.com](mailto:sales@suamerica.com)

**SAMPUTENSILI**



Member of the  
American Gear  
Manufacturers  
Association



# MANAGEMENT

## on the High Seas

**M**ost Navy brass would say that Commander D. Michael Abrashoff ran a loose ship. But his style of empowering his crew by delegating authority is changing the way the Navy thinks about management. His speech at the recent annual meeting of the American Gear Manufacturers Association offered a simple, common-sense approach that can be applied not only to running a ship, but also to gear manufacturing or any other industry.

Abrashoff's management style went against hundreds of years of naval tradition. As commanding officer of the 300 sailors aboard the *USS Benfold*, he sought to focus on the purpose and performance of the entire ship rather than on the chain of command. He did so by asking questions, probing his crew for ideas about what would make the ship more efficient, productive and combat-ready—never mind what it said in the Navy rule book. He wanted to know how to make every process on the ship better, and he found that the people performing each process best knew how to do this. He called it seeing his ship through the eyes of his crew.

Abrashoff found that many of the sailors grumbled about some of the tedious chores on the ship. One of those chores was the scraping and painting of the constantly rusting ferrous bolts and other hardware on the deck. Since that's the way the Navy had always done it, no one had ever tried to find an alternative. After a suggestion from one of his crew members, Abrashoff had every nut and bolt replaced with stainless steel. Now, the crew no longer has to scrape and paint the hardware. This gives them more time to work on what really counts—combat readiness.

People gain job satisfaction a number of ways, and management often overlooks many of the most important of them. Abrashoff polled his crew and made a list of the things they wanted out of their jobs. They said they wanted to be listened to, they wanted to be treated with respect and dignity, they wanted to know that their jobs have some impact, and they wanted to be told they're doing a good job. Of course, workers also want to be well paid, but according to Abrashoff's survey, pay was a surprising number five on the list. There are far better ways to motivate a crew, he says.

For example, Abrashoff told a story about a young man in his crew who was constantly in trouble. He lacked responsibility, discipline and a sense of purpose. Instead of berating the crewman or calling him out in front of his peers, Abrashoff wrote a letter to the young man's parents, telling them what a valuable member of the crew their son was and what an important contribution he was making to the success of the ship. Shortly thereafter, the sailor came to Abrashoff. The young man

had just spoken to his father, and as it turns out, it was the first time his father had ever told his son that he was proud of him. Abrashoff never had a problem with the young man again.

When Abrashoff took over the *Benfold*, the ship was one of the lowest rated in the Navy. The crew suffered from low morale and had poor performance ratings. The entire Navy has had a hard time recruiting and retaining sailors, but the *Benfold* had one of the lowest retention rates in the fleet.

The results of Abrashoff's changes have been dramatic. The *Benfold* is still one of the most sought-after transfers in the fleet. On average, only 54% of U.S. Navy sailors stay with the Navy after their second tour of duty. Under Abrashoff, 100% of his sailors signed on for an additional tour. The ship has also received numerous awards, including the coveted Spokane Trophy, awarded to the most combat-ready vessel in the Pacific Fleet.

I've always considered myself to be a good manager, as most managers do, in that I try to see things through the eyes of my employees. We have periodic reviews with our employees, and some of the things I've learned about my own operation have surprised me. For example, several years ago, our company had no answering machine. We never thought that we might be missing phone calls until one of my employees suggested it. She was always the first person here in the mornings and would often field phone calls well before normal business hours. I would never have known about it if I hadn't asked.

Seeing through the eyes of your crew is not something that you should do just at annual review time. To be truly effective, it has to be routine. Within any industry, all managers—not only in manufacturing and design, but also in maintenance, accounting, marketing and order processing—can use these ideas to make their departments combat-ready.

On a daily basis, Abrashoff used 600 eyes rather than two. How many eyes are working for you?



A handwritten signature in black ink that reads "Michael Goldstein".

Michael Goldstein, Publisher and Editor-in-Chief



# THE CLEAN REVOLUTION



*Helping gear makers reduce production costs and improve quality with ecologically responsible dry cutting technology. That's the Clean Revolution from Sigma Pool.*

*Dry Cutting Meets Production Engineering Goals Worldwide:*

- Coolant-free high-speed cutting
- 95% or greater machine uptime
- 35% production cost reduction
- 30% reduction in system cost
- Greater standardization among machine components
- Reduction in floorspace requirements
- Certified quality management system - QS 9000, ISO 9001



# ION OF DRY HOBGING.

About Ecology and Economy  
of Cutting without Cooling Lubricants.



By the end of 1998, more than 200 million gears had been produced on Liebherr machines with dry-cutting technology.

The revolution is well underway. And it started with Liebherr's introduction in 1993 with high-speed dry gear hobbing, a giant first step in the direction of the 'clean factory'.

Since then, the Sigma Pool companies have embraced dry cutting technology, meeting head-on the economic and ecological challenges of the new millenium. Today, Liebherr represents the world's leading builder of dry hobbing machines. Klingelberg-Oerlikon generating machines are efficiently cutting spiral bevel gears without coolant. And the other Sigma Pool partners will be putting innovative high-speed dry cutting systems into practice very soon.

SIGMA  POOL

The Gearing Partnership of Klingelberg, Liebherr, Lorenz and Oerlikon.

For more on the Clean Revolution, contact  
Liebherr Gear Technology Co.  
1465 Woodland Drive, Saline, MI 48176  
734.429.7225 Fax: 734.429.2294  
e-mail: info@LGT.Liebherr.com.

CIRCLE 126

 **IMTS**  
Chicago, September 8-13, 2000

**Booth B 7040**  
in the Gear  
Generation Pavilion





# *The new MEGA a big success story*

## *Innovative Solutions in Gear Grinding*

*Höfler will deliver in the  
following 12 months:*

*3 x MEGA 1500  
3 x MEGA 2000  
1 x MEGA 2500  
1 x MEGA 3500  
1 x MEGA 4500*

*The MEGA series:  
Profile-Generating  
gear grinders  
for gear diameters up to 180"*

*If you like to know more  
about this success story,  
please contact:*

Höfler Maschinenbau GmbH  
Industriestr. 19  
D-76275 Ettlingen/Germany  
Tel. +49 7243 599-0  
Fax +49 7243 599165

Höfler Corp.  
Sky Manor Road  
Pittstown, N.J. 08867  
Phone (908) 996-6922  
Fax (908) 996-6977



## Deburring Can Be a Real Drag

Deburring automotive transmission sprockets is a costly, yet necessary process for producing high-quality parts. Most manufacturers use a mass finishing process that involves first placing loose parts in grinding or finishing media and then applying a vibratory or rotational motion to move the media across the surface of the parts.

Stackpole's Automotive Gear Division, in Mississauga, Ontario, has recently begun using a mass finishing process known as drag finishing, in which parts are attached to special fixtures and dragged in a planetary motion through the polishing media. According to the manufacturer of the equipment, Walther Trowal, this process increases efficiency and is successful at deburring contoured parts such as sprockets, while eliminating the possibility of part-on-part contact.

Stackpole manufactures powdered metal sprockets for the automotive industry. Their automotive gear division operates around the clock, producing 20,000 sprockets per day. Each sprocket must be deburred and cleaned of heat treat scale to meet customer specifications.

Prior to installing two Walther Trowal TMD 80-1 drag finishing units, Stackpole employed 10 workers per shift to operate centrifugal barrel mass finishing machines. Today, the company expects that they will be capable of finishing the same quantity of parts with only five employees per shift. In addition, annual consumable

costs, including the costs of finishing media, are expected to be one-third of their previous cost.

The new machines installed at Stackpole are the first of their kind from Walther Trowal. Earlier versions using the drag finishing principle were capable of finishing 10-30 parts per hour. However, the incorporation of an automatic unload system, as well as some advances in part fixturing, have greatly enhanced production capabilities, says Jeff Puckett, manufacturing manager for Walther Trowal. Each of the machines at Stackpole finishes approximately 500 pieces per hour.

Walther Trowal is a member of the USF Surface Preparation Group.

Circle 250

## RecurDyn: The Next Step in Virtual Prototyping

New product development, having gone from prototyping to rapid prototyping to virtual prototyping for parts, has taken the next step to virtual prototyping for whole systems with multibody dynamics software packages. While they allow designers to test a system under different circumstances, the way they handle data and images has tended to limit their flexibility. Now that has changed. Developed by Dr. Dae Sung Bae, a professor of mechanical engineering at Hanyang University in Seoul, Korea, RecurDyn offers users more flexible and realistic virtual prototypes than previously possible.

*Welcome to Revolutions, the column that brings you the latest, most up-to-date and easy-to-read information about the people and technology of the gear industry. Revolutions welcomes your submissions. Please send them to Gear Technology, P.O. Box 1426, Elk Grove Village, IL 60009, fax (847) 437-6618 or e-mail people@geartechnology.com. If you'd like more information about any of the articles that appear, please circle the appropriate number on the Reader Service Card.*

One example of this flexibility comes from the Samsung Motor Company. According to Dr. Hyuk Kim, a dynamic analyst formerly with Samsung, "Automobile simulations with differential gear models generally running at extremely high speed are frequently terminated in the middle of analysis and solutions. These situations are very sensitive to integration error tolerance. Meanwhile, the same simulations have been carried out successfully with RecurDyn without any numerical troubles."

According to Dr. Bae, the reason for this success is RecurDyn's reliance on a relative coordinate system. "Relative coordinate systems require the minimum number of coordinates to define a shape," said Dr. Bae. "Absolute systems require the maximum. Also, because they plot every point, absolute systems require more difficult governing equations of motion and have many constraints that relative systems do not." Dr. Bae explained that by using relative coordinates, the governing equations for motion are ordinary differential equations and not the more difficult differential algebraic equation. Also, because absolute coordinate systems define the design under analysis using a predetermined set of rules while the simulation



Sprockets in a drag finishing unit. Courtesy of Walther Trowal.



and analysis are running, the scope of that analysis is much narrower. "RecurDyn defines the system first," said Bae. "Then it does the analysis according to the situation parameters set by the designer, making it an ideal software package for "what-if" studies of virtual prototypes. With a relative system such as RecurDyn, the scope of analysis is much wider." Such analyses include multibody dynamics and kinematics as well as compliance characteristics.

Using RecurDyn is fairly simple from the operator's point of view, but gear and power transmission designers should understand that RecurDyn's strength is its multibody system modeling, not its gear design capabilities. According to Dr. Bae, "You would use CAD to generate the drawing and then import the geometry files into RecurDyn. Then you would install all the other mechanical elements needed to complete the system and run the analysis. After that, the soft-

ware plots the results and you can revise your system." RecurDyn can import shell, rapid prototype and IGES files. Plans are in the works to enlarge this list.

Dr. Bae was recently in the United States, holding meetings with various companies here in hopes of expanding on the success RecurDyn already enjoys in Korea. "Hyundai Motor Company has chosen RecurDyn as their standard dynamic analysis program due to not only easy customization but also RecurDyn's robust solver and user-friendly interface," said Chungsup Song, senior design engineer for Hyundai. Other large Korean firms, such as Samsung and LG, are still conducting trials with the software. According to Dr. Bae, his meetings in the U.S. were very positive and there is a great deal of interest on this side of the Pacific in both using and marketing RecurDyn.

Circle 251

Process Equipment Company Introduces The...

## NEXT DIMENSION™ Gear Measurement System

Now a Gear Measurement System that measures gears and related features with a true 3-D scanning probe!



# ND430

The Next Dimension™ measures tooth alignment, tooth profile, index and root radius utilizing these "Leading Edge" features:

- Linear Motors
- AGMA, DIN, ISO & User defined Analysis Packages
- Volumetrically Mapped Accuracy
- Software Developed using Microsoft Visual Studio 6.0
- Thermal Compensation
- Remote Diagnostics by Modem or Internet
- 0.1 Micron Resolution Scales
- Network Capability
- Renishaw® 3-D Scanning Probe

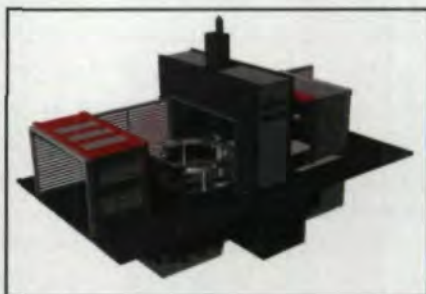


ISO 9001 Registered

Nurturing Ideas...New Dimensions In Gear Technology!

4191 US Route 40 • Tipp City, OH 45371  
Phone: 937-667-7105 • 800-998-4191 • Fax: 937-667-2591  
E-mail: metrology\_sales@processeq.com  
Or Visit Us At: www.processeq.com

CIRCLE 123



Höfler's Porta 3000

## World's Largest Internal Gear Grinder

The year 2000 will see the arrival of the world's largest internal gear grinder at the Höfler works in Ettlingen, Germany. Designed to meet the growing demand for large, high-quality ground gears, the Porta 3000 can grind internal gears up to 3 meters in diameter with face widths up to 900 mm and weights up to 35,000 kg. The workpieces are usually precut or cast gears that are put on the Porta 3000 for finishing.

The machine is designed from the ground up for high accuracy. Across the hydrostatically operated machine table and table slide, built below floor level, extends a massive mineral cast gantry made from a concrete polymer bond. "The vibration dampening ability of the



mineral cast is at least 20 times better than that of cast iron with greater thermal stability," said Omar Sharif, sales manager. "Also, it costs 25% less to manufacture and makes assembly of the machine faster and easier because very little work is needed to finish the pieces. The machine stands are almost ready because the steel mechanical connections are pre-manufactured and placed in the molding form prior to casting." On this is mounted the rigid grinding slide with a large grinding wheel and 30 kW hydraulic motor wheel drive. This design allows the machine to grind both internal and external gears (in the profile grinding mode). The grinding slide strokes vertically through the gear with the grinding wheel swiveled into the tooth angle. Cutting oil is the primary lubricant for the grinding operation. The oil is applied using high-pressure pumps that dispense the oil through specially shaped oil supply nozzles to the tooth gap surface. "Grinding time for a pre-cut gear of the largest size would be about five hours," said Sharif.

The Porta 3000 now offers industries where precision in large gears is a necessity the same level of quality that grinding has offered to consumers of smaller gears. These include the wind power and naval shipbuilding industries, where gears have to meet very tight quality standards for the kind of quiet and efficient operation demanded. "From the Porta 3000," said Sharif, "we can expect gears to meet DIN 3 (AGMA 14) quality standards." This is verified by the machine's on-board inspection system. Designed and assembled by Höfler, the Porta 3000 employs a CNC inspection system that uses touch probes to inspect the workpieces. "We use an integrated inspection system for the automatic inspection of involute, lead and pitch," said Sharif. "The diagrams can be reviewed on the screen and documented on a laser printer according to the DIN 3962 standard, which details tolerances for cylindrical gear teeth in terms of deviations in individual parameters, tooth trace and pitch span. All such deviations are corrected based on the inspection results."

The first Porta 3000 machine was installed in Höfler's own climate-con-

trolled production building in Ettlingen, Germany, and brought online in March. According to Sharif, the company extended its production floor space by 8000 square feet to accommodate the Porta 3000. "Business will be very good with the Porta," said Sharif. "We have a lot of demand for it." ○

Circle 252

**Tell Us What You Think . . .**

If you found this column of interest and/or useful, please **circle 253**.

If you did not care for this column **circle 254**.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send an e-mail message to [people@geartechnology.com](mailto:people@geartechnology.com).

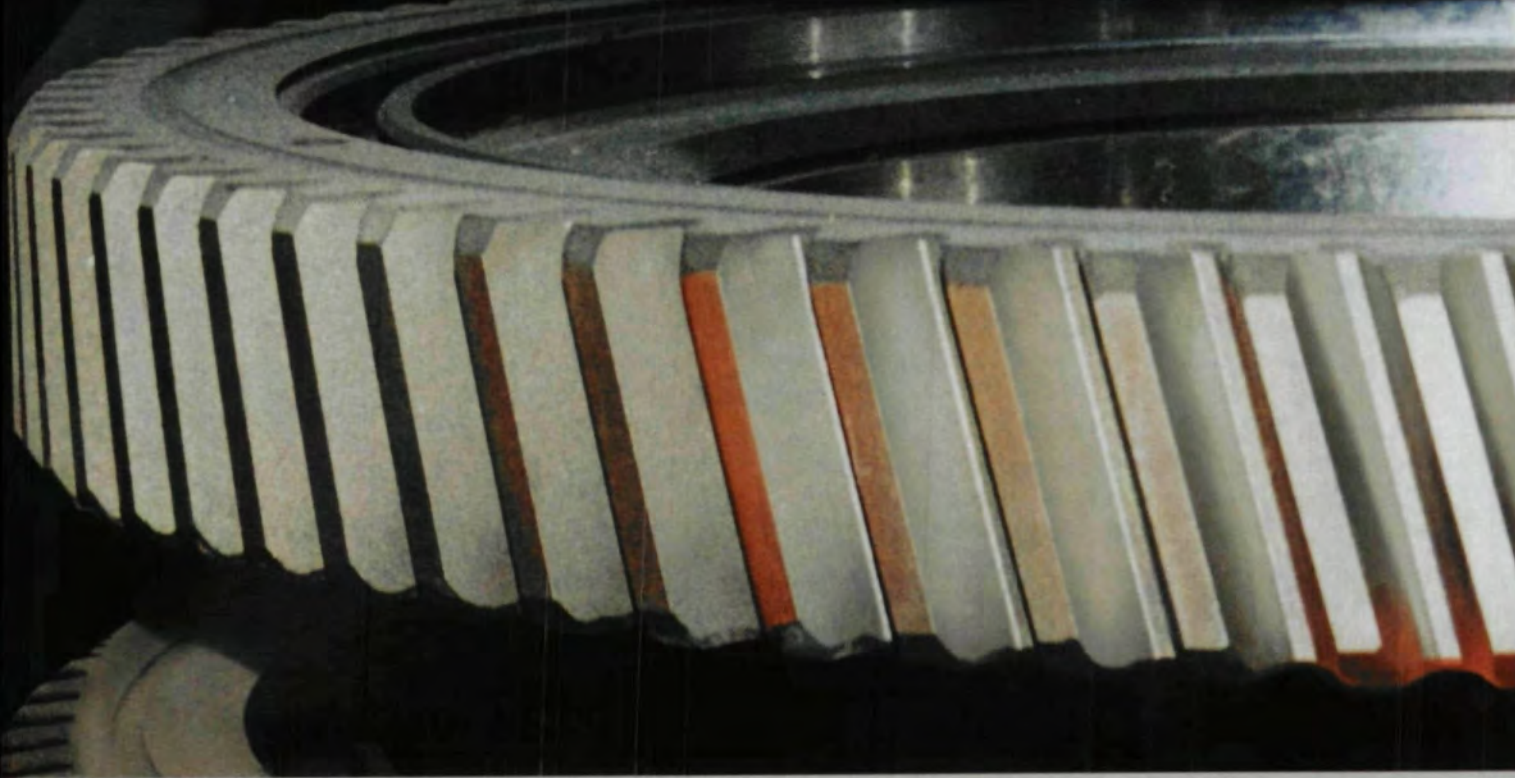
*If you're making parts like these, and want to make them twice as fast or at half the cost*

*we'll show you how at:*  
**leistrizcorp.com**

**Leistriz**  
*The World Leader in Whirling Technology*  
(201) 934-8252

CIRCLE 119



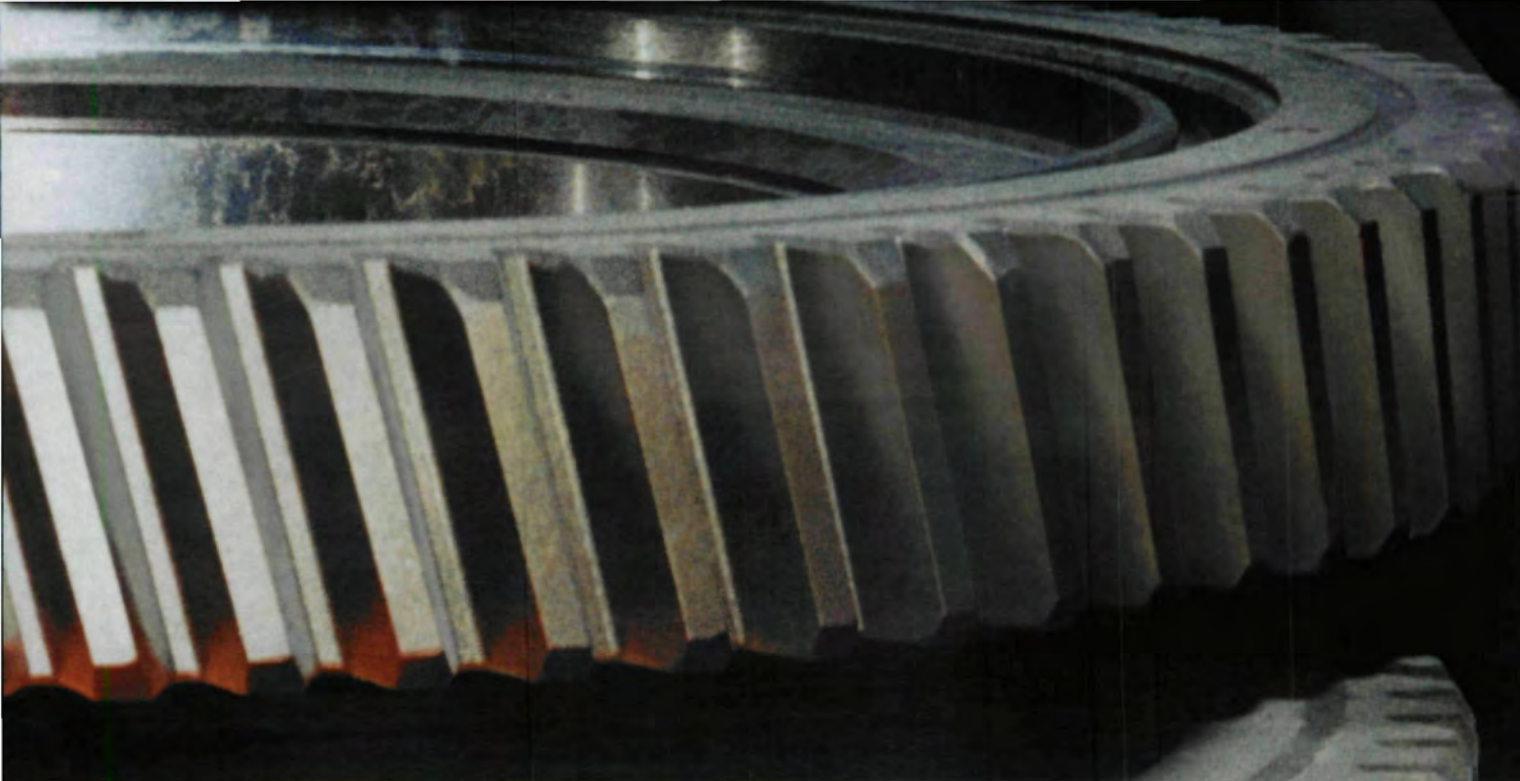


# TECHNOLOGY

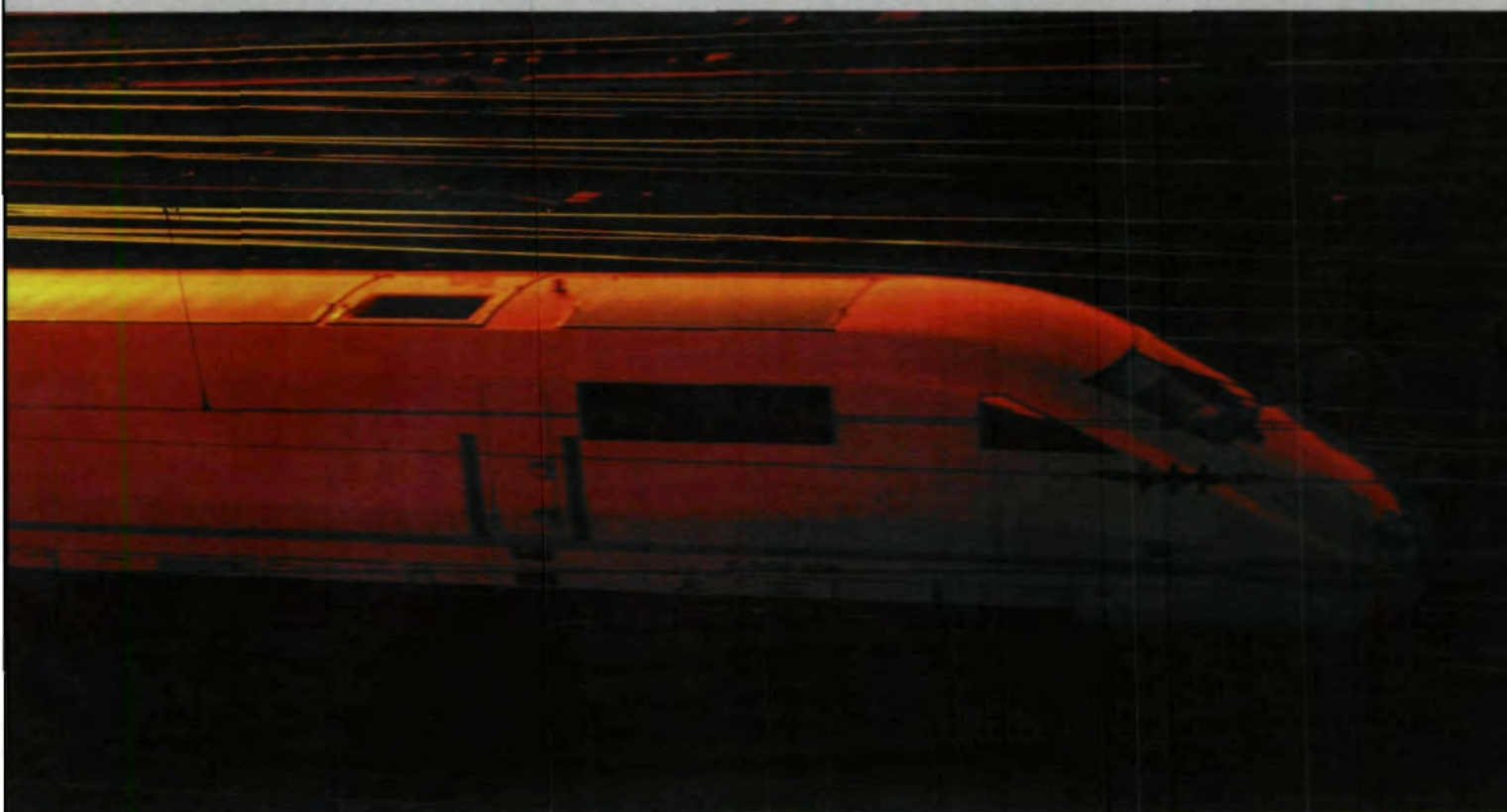


KAPP and NILES are manufacturers of gear and profile grinding machines for the automotive, aerospace and commercial industries: innovative - reliable - efficient. Call us for details.





# BY NILES



Representing KAPP, NILES and KAPP TECH:  
KAPP SALES & SERVICE LP, 2870 Wilderness Place,  
Boulder, CO 80301, Phone (303) 938-9737, Fax (303) 447-1131

CIRCLE 145

**KAPP**  
SALES & SERVICE



# DON'T MESH WITH ANYTHING LESS



## PRESRITE NEAR-NET GEARS ARE NEAR PERFECT

*If you want the best gears money can buy, invest some time with Presrite. We've already invested millions to build a world-class gear forging plant. A dedicated facility equipped with a state-of-the-art gear lab, high-capacity presses, and the latest in sophisticated machinery.*

*The results are gear-making capabilities that are second to none. We hot-forged gears economically to near-net shapes. Because we can meet such tight tolerances, there's little or no hobbing required. The inherent strength of the forging is maintained while costly roughing and finishing operations can be eliminated.*

*See why customers around the world—in all types of industries—have come to rely on Presrite for high-quality forged gears. Contact us today for more information or a quote.*



**Presrite Corporation**

3665 East 78th Street, Cleveland, Ohio 44105  
Phone: (216) 441-5990 • Fax: (216) 441-2644

ISO 9002-Registered Company

CIRCLE 108

*We're as NEAR as the NET! Visit our Web site at [www.presrite.com](http://www.presrite.com).*



## ADVERTISER INDEX

For more information about a product or service advertised in this issue of *Gear Technology*, circle the appropriate number on the Reader Response Card and put the card in the mail.

### NEW! TRY OUR RAPID READER RESPONSE SYSTEM!

Go to [www.geartechnology.com/rrr.htm](http://www.geartechnology.com/rrr.htm) to request additional information from any advertiser in this issue. Your request will be sent to the advertiser within 24 hours for super-fast turnaround!

ADVERTISER	READER SERVICE NUMBER	PAGE NUMBER
A/W Systems Co., Inc.	103	41
Ajax Magnethermic	162	68
Akron Gear & Engineering	176	46
American Metal Treating Co.	151	70
American Wera	127	34
Applied Process	163	68
Asano America, Inc.	136, 195	37, 47
ATA Gears Ltd.	113, 160	63, 46
B&R Machine & Gear	206, 207	17, 47
Barit International Corp.	141	4
Basic Incorporated Group	146	36
Becker Gearmeisters	197	70
Bourn & Koch Machine Tool Co.	147	61
The Cincinnati Gear Co.	193	69
Colonial Tool Group	209	71
D.I.G.I.T., Inc.	202	18
Dura-Bar	158	39
Erlbacher Gear & Machine	196	46
Euro-Tech	129	18
Fässler	205	38
Forest City Gear Co.	138	6
Gearmakers	184	45
General Magnaplate	164	68
Gleason Corporation	110, 166	IFC-1, 69
Gleason Pfauter Hurth Cutting Tools	105, 152, 167	BC, 70, 68
Gröb, Ernst	111	31
Halifax Rack & Screw Cutting Co.	183	45
Höfler	112, 169	10, 68
Holroyd	130, 170	69, 68
Ikona Gear Technologies	181	46
IMTS	118	64
Innovative Rack & Gear	182	45
Inscor Corporation	148	36
ITW Heartland	116	43
Kapp GmbH	145	14-15
Koro Sharpening Service	153	71
Kreiter-Geartech	204	70
Laser Machining, Inc.	131	67
LeCount, Inc.	142	29
Leistriz Corp.	119	13
Liebherr Gear Technology	126	8-9
M&M Precision Systems	165, 171	26, 69
Macsteel	104	35
Midwest Gear & Tool	203	61
Midwest Gear Corp.	154	70
Milwaukee Gear Company	122	42
Mitsubishi Machine Tools	198	65
National Broach & Machine Co.	186	5
Niagara Gear Corp.	155	71
Ohio Broach & Machine Co.	199, 200	19, 70
On-Line Services	144	29
Parker Industries	149	4
PC Enterprises	192	70
Peerless-Winsmith	188	45
Perry Technology	134	IBC
Presrite Corp.	108, 172	16, 68
Process Equipment Co.	123	12
Pro-Gear Co., Inc.	156	71
The Purdy Corporation	201	66
Quality Transmission Components	173	68
REM Chemicals	125	30
Star Cutter Co.	128, 157, 174	2, 70, 69
Supreme Gear Co.	190	45
Toolink Engineering	208	37
United Tool Supply	137	67
Valley Gear & Machine Co.	191	46

# B&R

## Machine and Gear Corporation

Member: American Gear Manufacturers Association

- A family owned and operated business for 25 years, 1974-1999.
- A custom job shop manufacturing gears to your specifications or samples.
- Spiral bevel gears to 66" PD.
- We have our own Material Warehouse, Gearbox Repair Facility and full Heat Treating capabilities in-house.
- Breakdown services our specialty.

Call for a Brochure and complete capabilities list.



PO BOX 536, 4809 US HWY 45,  
SHARON, TN 38255  
(901) 456-2636 FAX (901) 456-3073  
WATS LINE: 1-800-238-0651

CIRCLE 206

# LOOK FOR THE PTHP SYMBOL ON PAGES 57-62

All these companies can be found on  
*The Power Transmission Home Page™*.

### VISIT TODAY TO:

- Select by product specifications and manufacturing capabilities.
- Send RFQs to the companies of your choice from one easy-to-use online form.
- Find the latest industry news and new product listings for gears, bearings, motors, speed reducers and more.

[www.powertransmission.com](http://www.powertransmission.com)





# Frenco Hand Held Dynamic Indicating Spline Gages



Measures and Charts in Seconds!

- Size (dimension between balls)
- Taper
- Roundness

Fast and economical shop floor inspection of internal spline characteristics has never been easier. Frenco's new digital dynamic handle combined with the time proven 1x1 indicating spline gage head provide all of the important information required to insure spline quality.



N48 W14170 Hampton Avenue  
Menomonee Falls, WI 53051-6907  
Phone 262-781-6777  
Fax 262-781-2822  
www.eurotechcorp.com

CIRCLE 129

DIGITAL  
INTERFACE  
GEAR  
INSPECTION  
TERMINAL

## DIGIT INC.

P.O. Box 367, Springboro, OH 45066

Fax: 513/746-5103 • e-mail: [digit@erinet.com](mailto:digit@erinet.com)

**CALL 513/746-3800**

- SHAFT GAGES
- GEAR GAGES
- INTERNAL/EXTERNAL
- CUSTOM GAGES



less than **10% GRR**

**ON PROCESS SOFT PART - GUARANTEED**



- QUICK**
- QUOTE
  - DESIGN
  - DELIVERY



CIRCLE 202



### New Vice President of Sales at American Wera



Jim Eaton

American Wera has appointed Jim Eaton vice president—sales. Eaton will oversee sales and engineering planning for American Wera gear cutting, gear pointing and Profilator® machines; Hurth MODUL hobbing and bevel gear cutting machines; and Präwema gear honing machinery. He will also be the key contact for the range of gear processing machinery now marketed and serviced by American Wera.

### New Executive Director for the AGMA Foundation

The American Gear Manufacturers Association (AGMA) has made Joanne S. DiCesare the new executive director of the AGMA Foundation. DiCesare will work with the Foundation's Board of Trustees to promote the organization's objectives supporting international standards, education and research of interest to the gear industry.

### Schafer Gear Works Relocates to New Facility



Schafer Gear Works, Inc.

Schafer Gear Works, Inc. has dedicated a new 100,000 sq. ft. manufacturing facility in South Bend, IN.

The layout of the shop floor is unique for the industry," explained Doshi. "It allows us to use as much computer technology and automation as is practical, including in-line quality control."

### Obituaries

#### Stewart Ward, Former President of Brad-Foote and AGMA



Stewart Ward

Stewart Ward, retired president and CEO of the Brad-Foote Gear Works, passed away following a February 4<sup>th</sup> motorcycle accident near his home in Windermere, Florida. He was 62. A past president of AGMA (1991-1992), Ward was a recipient of the AGMA Board of Directors Award (1990) as well as AGMA's coveted "Old Goat"

Award. He started at Brad-Foote as general manager in 1973 and became president and co-owner in 1987. "Stewart was like the father of Brad-Foote Gear that everybody looked up to," said long-time friend and associate, Redmond Ryan. "He had the ability to make a friend out of everyone he met." Ward is survived by his wife of 22 years, Donna; his children Kenneth, Brian, Diana Royer, Kristine Armstrong; mother, Doris Lyons; brother, Carson Ward; and six grandchildren.

#### Gear Inventor and Science Fiction Writer Oliver Saari

Oliver Saari, inventor of a variety of gear and power transmission devices including the Spiroid and Helicon gear drives, has passed away at the age of 82. Saari was an engineer and inventor at the Illinois Tool Works in Chicago from 1945 to 1974. According to Faydor Litvin, Director of the Gear Research Laboratory at the University of Illinois at Chicago, "Saari's inventions bear the features of an unorthodox way of think-

ing, which resulted in original ideas that have already been applied in industry and will be widely used in the future."

Gears were Saari's primary interest, but he was also a prolific science fiction writer. His stories were printed from 1936 to 1953 in such pulp magazines as *Astounding Science Fiction*, *The Magazine of Fantasy and Science Fiction*, and *Startling Stories*. Writing for the "pulp," Saari developed friendships with writers like Robert Heinlein, C.D. Simak, Gordon R. Dickson and Poul Anderson. ☉

#### Tell Us What You Think . . .

If you found these items of interest and/or useful, please circle 255.

If you did not care for these items, circle 256.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).

## Table-Up Broaching Machine

- Eliminates Broaching Pits and Elevated Platforms
- Increases Cell Design Flexibility
- Facilitates Machine Relocation
- Allows a Range of Optional Equipment and Secondary Operations

**Available in strokes from 36" to 72" and tonnages from 5- to 30-ton capacity.**

For broaches, broaching equipment, broach repair/resharpening, and production broaching services, call your total broaching source.

**Ohio Broach & Machine Company**  
 Phone: (440) 946-1040  
 Fax: (440) 946-0725  
[www.ohiobroach.com](http://www.ohiobroach.com)

©2000, The Ohio Broach & Machine Co.



# The Design and Testing of a Low Noise Marine Gear

J. J. Bos

## Introduction

This article offers an overview of the practical design of a naval gear for combined diesel or gas turbine propulsion (CODOG type). The vibration performance of the gear is tested in a back-to-back test. The gear presented is a low noise design for the Royal Dutch Navy's LCF Frigate. The design aspects for low noise operation were incorporated into the overall gear system design. Therefore, special attention was paid to all the parameters that could influence the noise and vibration performance of the gearbox. These design aspects, such as tooth corrections, tooth loading, gear layout, balance, lubrication and resilient mounting, will be discussed.

The back-to-back configuration was built with two gears, intermediate shafts and a torque actuator for load simulation. The tests were done for gas turbine and diesel engine propulsion modes at approximately 3,000 kW power input. This corresponded to a propeller shaft speed of 93 RPM. The torque actuator for this test configuration was rated for a maximum torque of 45 kNm and a maximum speed of 3500 RPM. The required torque during testing amounted to 33 kNm at 875 RPM.

## Design Requirements

The propulsion system for the LCF consists of two independent, opposite-handed propulsion lines. One is for the starboard and the other is for the portside propeller shaft line. Each is equipped with a Controlled Pitch Propeller (CPP) as well as boost gas turbine and cruising diesel engine propulsion modes.

The design of each gear set had to meet specific requirements, the most important of which are listed below:

- Gear Ratings

- Diesel Engine Propulsion

Power	5,000 kW
Input Shaft Speed	1,000 RPM
Output Speed	103 RPM

- Gas turbine Propulsion

Power	19,500 kW
Input Shaft Speed	5,450 RPM
Output Speed	164 RPM

- Propeller Shaft Speed Range:

- min. 50–max. 164 RPM

- Input Power Range:

- min. 1,200 kW–max. 19,500 kW

- Oil supply for the gear by gear-driven pump in the propeller speed range of 64–164 RPM.

- Shock resistant for shocks up to 13 g.

- The structure-borne noise requirements for above and below the resilient mounting are defined for a shaft speed of 93 RPM.

- The fulfillment of the structure-borne and airborne noise requirement shall be demonstrated in a back-to-back test.

- Noise requirements for airborne and structure-borne noise according to Navy specification.

In respect to the above mentioned design requirements, to have optimal corrections for loaded conditions and to optimize tooth loading, the number of rotating elements under load was minimized for both gas turbine and diesel engine propulsion systems. The gears are mounted on a resilient mounting in order to optimize the damping of higher frequency range vibrations to reduce underwater noise levels.

Printed with permission of the copyright holder, the American Gear Manufacturers Association, 1500 King Street, Suite 201, Alexandria, Virginia 22314. Copies of the paper are available from the Association.

Statements presented in this paper are those of the Author and may not represent the position or opinion of the American Gear Manufacturers Association.

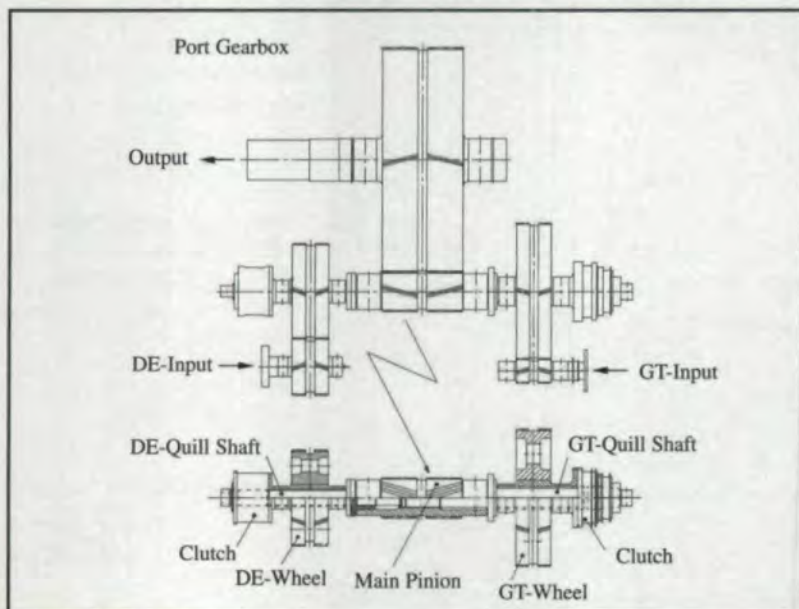


Fig. 1—Layout of the gear elements.



The thrust block for this design is a separate item that is rigidly mounted in the propeller shaft line. The whole gear train in the gearbox has a 15 mm freedom of movement to accommodate the relative movement of the gearbox to the shaftline. This movement is caused by displacements of the gear case due to the resilient mounting and shock loads.

The overall size of the gearbox is approximately 5 x 5 x 4 meters. There are 35 flexible mounts, which require a rigid casing for optimal performance. The stiffness of the casing was checked by means of a finite element analysis. In combination with the flexible mounting, the stiffness of the gear casing is an important feature.

#### Layout

The first objective was to design a gear layout (see Figure 1) that could meet the requirements as specified within the available space of the gear compartment and with the correct geometric positions for the input shafts of the diesel and gas turbine engines as well as the output shaft. Important features for the design are a balanced tooth load, a minimal number of rotating elements, and the elimination of element rotation when in an unloaded condition.

The layout that was chosen for this purpose was a two-stage reduction for both diesel and gas turbine propulsion modes. The second stage is a common stage for both propulsion modes.

The thrust block is a separate item in the shaft line. The whole gear train is axially positioned by this thrust bearing. The first reduction of diesel and gas turbine input requires, therefore, a connection to the second reduction pinion in the axial direction. The clutches are, therefore, equipped with axial bearings. The rotating parts, therefore, float in the gear casing in an axial direction.

#### System Design

**Gears and Clutches.** The construction of the first reduction pinions and wheels is based on solid forgings. The construction of the second reduction is based on assemblies. The main wheel is a fabricated structure shrunk onto the main shaft. A center driven second reduction pinion was required to be able to establish a good tooth contact pattern in both gas turbine and diesel engine propulsion. The construction of the second reduction pinion is a center shaft with a specially designed intermediate sleeve on which the pinion body is shrunk. Due to this special design, the assembly of pinion, quill shafts and sleeve consists of 5 items.

For the several operational modes, two clutches have been built in. The second reduction pinion is connected to these clutches by means of quill shafts (Figure 1). The gas turbine reduction wheel

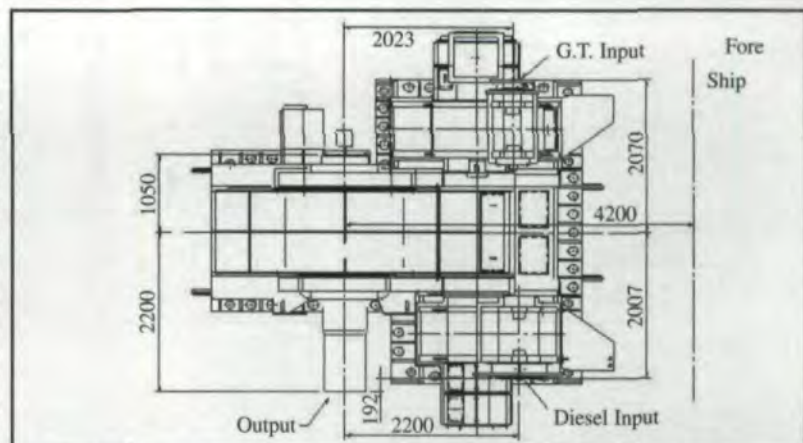


Fig. 2—Top view of the portside gearbox. All dimensions in millimeters.

Table 1—Overview of all rotating parts.

	GT Pinion	GT Wheel	DE Pinion	DE Wheel	Main Pinion	Main Wheel
Material	17CrNiMo6	17CrNiMo6	17CrNiMo6	30CrNiMo6	17CrNiMo6	32CrNiMo12
Heat Treatment	Carburized	Carburized	Carburized	Through Hardened	Carburized	Nitrided
Module	6.5	6.5	6.5	6.5	8	8
Number of Teeth	40	231	94	158	53	305
Quill Shafts		30CrNiMo8		30CrNiMo8	30CrNiMo8	
Main Shaft						C50E+QT

is equipped with a self-shifting, synchronizing clutch connected to the quill shaft of the second reduction pinion. The diesel engine reduction wheel is equipped with a hydraulically operated multi-plate type friction clutch connected to the quill shaft of the second reduction pinion. Table 1 gives an overview of all rotating parts.

The underwater noise spectrum of the ship can be identified by the first and second order tooth frequencies if they dominate the noise spectrum. The distinctive role of the tooth frequencies in the vibration spectrum of the gear should be avoided.

Therefore, the gear design required a high total contact coefficient, which is realized with a double helical gear design with a pametrada tooth, a 16° pressure angle and a module as small as possible with acceptable tooth load. All tooth calculations are based on Lloyd's Rules of Shipping, DIN and ISO regulations.

The oil pumps mounted on the gearbox also required an optimal design with regard to noise generation.

Tooth corrections are made by correction of the helical angle and tip relief in combination with tooth end relief. The tooth corrections for this gear were based on our own experience and programs for tooth corrections, and secondarily on calculations done by the Design Unit of the University of Newcastle, UK. The program for tooth correction calculation is the DU-GATE program, designed for tooth correction calculations in order to minimize the transmission error. The accuracy level for the

#### Ir. Johan Bos

is the technical manager of Schelde Gears. He received his degree in mechanical engineering at the Technical University of Delft in the Department for Tribology in 1980. After working in the fields of research and general mechanical engineering, he joined Schelde Gears in 1993. His responsibility is the design and development of low noise reduction gears. Schelde Gears specializes in reduction gears for naval and merchant marine vessels, where stringent noise specifications are applied.



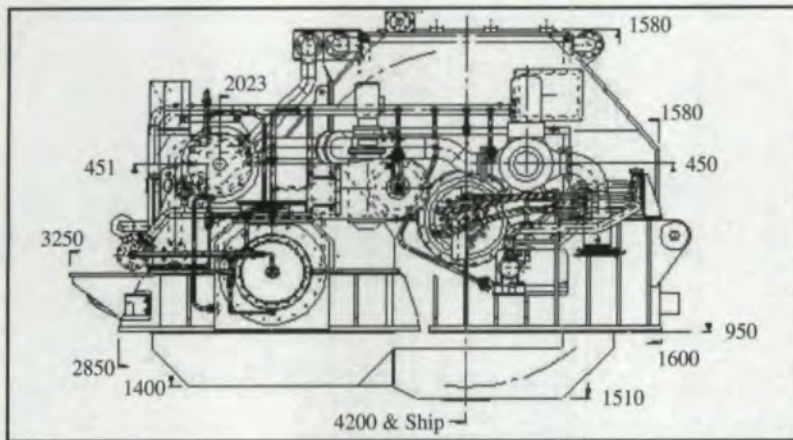


Fig. 3—Front view of the portside gearbox. All dimensions in millimeters.

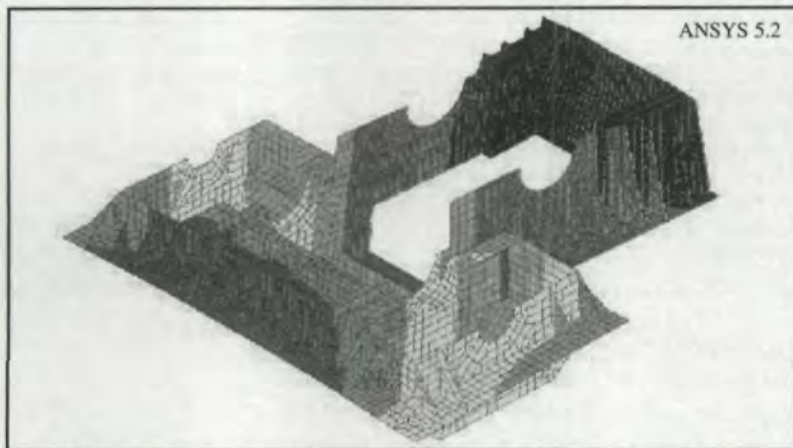


Fig. 4—Displacement calculation of lower part casing for GT propulsion.

gear elements is in accordance with ISO 1328 Class 3 requirements. All these design aspects contribute to low airborne and structure-borne noise levels for the gearbox.

Optimal tooth corrections are based on full load conditions. The calculations for transmission error were made for loads in the operational modes with noise requirements. The tooth corrections are based on bending, including shear, torsion and the bearing position. Other parameters such as wheel deformation and housing deformation were in this case negligible. The design of the second reduction pinion required a central driven construction in order to have optimal tooth loading for both gas turbine and diesel propulsion modes.

**Gear Casing Design.** The design of the overall gear casing calls for separate casings for the diesel first reduction, the gas turbine first reduction, and the second reduction. The casings are fabricated constructions with solid walls. Noise requirements led to the decision to use a solid wall. For stiffness purposes, a fabricated structure with double wall construction would have served this purpose best. However, because the distance between the shaft center lines and the foundation is relatively low (<800 mm), a double wall casing would be difficult to design and produce. The casings are assembled

to one bolted construction before machining is performed. The casing has overall dimensions of 4 x 5 x 4 meters (Figures 2 and 3) and has a separate sump integrated into the hull of the ship.

The stiffness of the gear casing is an important item for two reasons. First, to perform correctly, the resilient mounting requires a stiff gear casing. Secondly, due to asymmetric loading of the casing, misalignment is possible in combination with the resilient mounting and insufficient stiffness of the casing. The stiffness of the casing is checked using a finite element analysis (ANSYS) calculation.

In Figure 4, the calculation result for one operational load is presented. The bearing loads for full torque are applied to the structure for both gas turbine and diesel engine modes with an applied torque of 33 kNm on the gas turbine input shaft and 48 kNm on the diesel input shaft. The output shaft has a torque of 1106 kNm for the gas turbine engine mode and 464 kNm for the diesel engine mode.

These kinds of analyses are performed on all new gearbox concepts, and the acceptance limits for the deformation results are generally based on the bearing requirements. The acceptable misalignment between two radial bearings is limited to an angle of approximately  $10^{-5}$  radians. For axial bearings the acceptance depends on the type of bearing tilting pad or tapered land bearings being used, but the limits are approximately  $10^{-3}$  to  $10^{-5}$  radians.

**Bearing Concept.** The bearings are located close to the gear elements, giving the most effective stiffness to the pinions and the wheels. The bearing manufacturer uses an accurate program for calculating the bearing dimensions, clearances, required flows and losses. An important aspect for the journal bearings is to define all possible modes of operation. These consist of all relevant combinations of load, load angle and speed. For this gearing, all bearings are journal bearings. The axial bearing for all reductions is integrated into the axial thrust bearing located in the propeller shaft line, approximately 10 m aft of the gearing. As the whole gear train has only one axial bearing, the first reductions of diesel and gas turbine input need to be axially locked to the second reduction for times when the reductions are disengaged or are running engaged. These possible modes of operation, therefore, require that all bearings have an oil supply in all operational modes.

**Oil Supply System.** A main gear driven oil pump is used for the oil supply to the bearings and the tooth lubrication under operational conditions. The gear driven pump supplies the gear with oil over an output shaft speed range of 50 to 164 RPM. The oil consumption of the gear is almost constant



over this speed range, while the oil supply from a spindle type oil pump increases with the speed. To avoid large overcapacity and large overflows at higher speeds, a special pump with constant output pressure and variable flow is used. The result is that for each mode of propulsion in this design, the oil supply is just the required amount. The control of this flow is based on a constant pressure in the main supply line. The input pressure for the various users will, therefore, be constant.

In the propeller speed range of 0 to 50 RPM, and in emergency cases, an electric pump is used. The takeover from electric to gear driven pump is done by a trigger signal at a shaft speed of 50 RPM. The pump will take over within a fraction of a second. The required oil flow is presented in Figure 5.

The oil for the friction clutch engagement is supplied by a separate electric driven oil pump. A gear driven pump directly coupled to the diesel engine input pinion supplies the oil required for keeping the friction clutch engaged.

A separate skid is mounted between the gears to accommodate the lubrication oil filter, cooler and the electrically driven oil pumps and cooling water pumps for both gears.

#### The Resilient Mounting

As the gear is mounted on a resilient mounting and the gear elements are axially positioned by the thrust block, the whole casing will have movement relative to the gear elements. Under normal conditions this movement could be approximately 0.2 to 0.5 mm in all directions. This, of course, depends on sea conditions. For extreme shock conditions, the movement of the gear casing is limited in the vertical direction to  $\pm 2$  mm by shock limiters. However, due to the movement of the thrust block position relative to the position of the gear casing foundation, the total required relative movement could be  $\pm 15$  mm in the axial direction. A sketch of the resilient mounting is shown in Figure 6.

The purpose of the resilient mounting is to reduce underwater noise level, thus increasing the difficulty in detecting and recognizing the ship. The noise requirements below the mounts and above the mounts are calculated based on the impedances from the ship's structure and the water.

The resilient mounting was specified to have a natural frequency of 20–25 Hz. The reason for this frequency is that an optimal damping of frequencies is required for frequencies over 60 Hz. A choice in this respect has always to be a compromise. Lower frequency vibrations are normally caused by imbalance and misalignment forces. An effective damping of these frequencies should then require a very soft, resilient mounting with

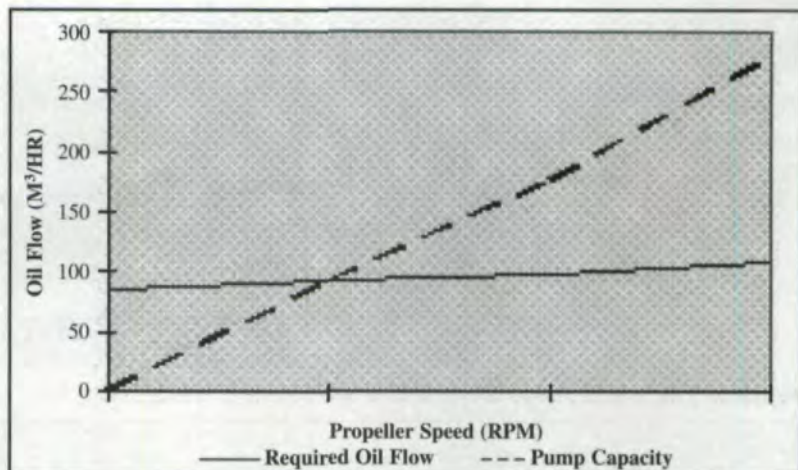


Fig. 5—Oil flow requirements.

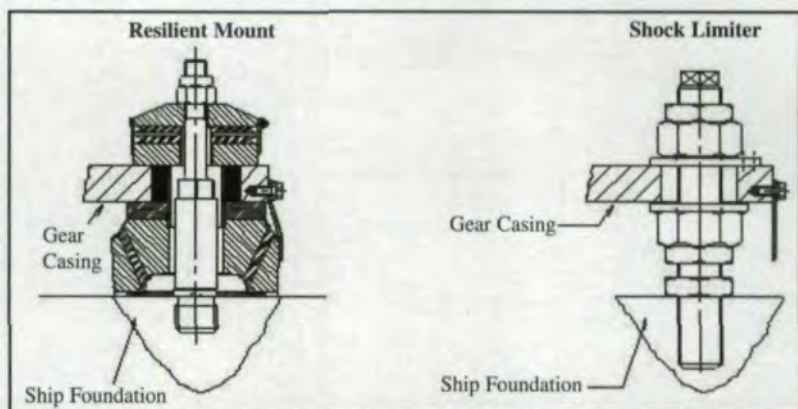


Fig. 6—Resilient mounting and vertical shock limiter.

Table 2—Shaft and tooth frequencies for a low noise operation mode.

POSITION	SHAFT FREQUENCY	TOOTH FREQUENCY
Main Wheel	1.5 Hz	400 Hz
Main Pinion	7.5 Hz	400 Hz
DE Pinion	11.5 Hz	850 Hz
GT Pinion	50 Hz	2000 Hz

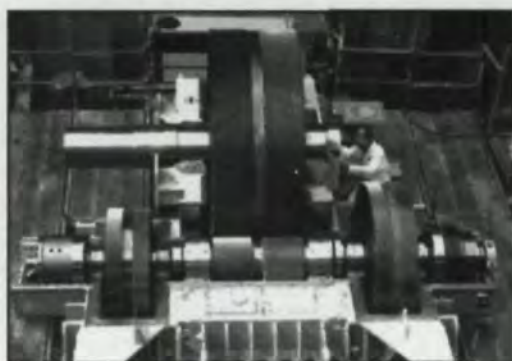


Fig. 7—Assembly floor, portside gearbox.

low natural frequencies. The frequency range for the resilient mounting is especially chosen to reduce the levels for the tooth frequencies in the underwater noise. A list of shaft and tooth frequencies is given in Table 2.

The gearbox, mounted on 35 such resilient mounting devices, is isolated in the vertical and horizontal direction from the ship structure. The rubber compound is tuned with the requirement for the performance of the resilient mounting, e.g. the damping



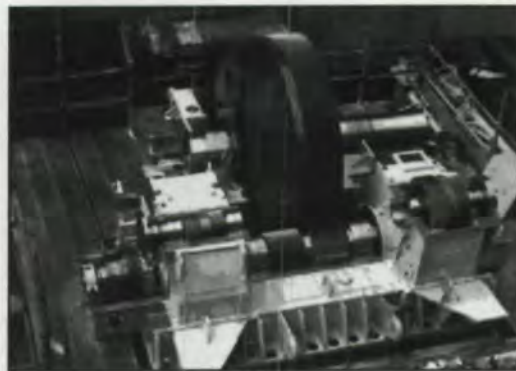


Fig. 8—Assembly floor, starboard gearbox.

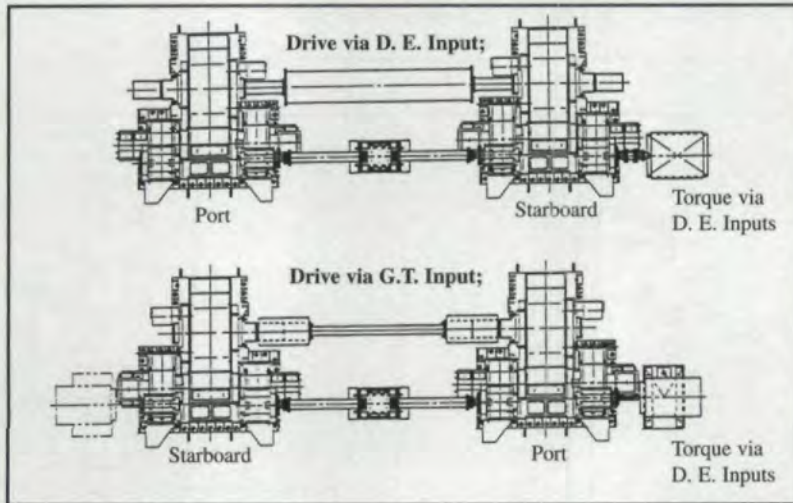


Fig. 9—Back-to-back arrangement.

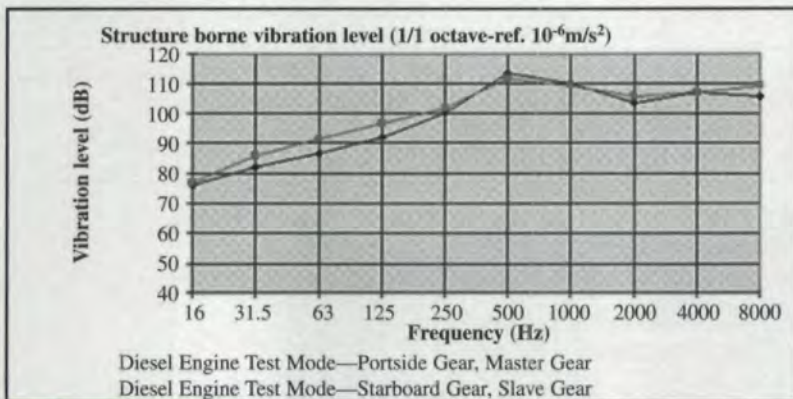


Fig. 10—Measurement results from back-to-back test.

Table 2—Test configurations and conditions.

	Portside Gear	Standard Gear
<b>G.T. Test Mode</b>		
Test Portside Gear	Master	Slave + E-drive
Test Starboard Gear	Slave + E-drive	Master
Position Torque Actuator	G.T. Input	G.T. Input
Load Characteristic	Master-Positive Torque	Master-Positive Torque
	Slave-Negative Torque	Slave-Negative Torque
<b>D.E. Test Mode</b>		
Test Portside Gear	Master	Slave + E-drive
Test Starboard Gear	Slave + E-drive	Master
Position Torque Actuator	D.E. Input	D.E. Input
Load Characteristic	Master-Positive Torque	Master-Positive Torque
	Slave-Negative Torque	Slave-Negative Torque
<b>Test Conditions</b>		
Load		3,000 kW
Diesel Propulsion		875 RPM
Gas turbine Propulsion		2,950 RPM

of the natural frequency as well as the dynamic damping of higher frequencies. The available space for movement is limited by separately mounted shock limiters. These are separate devices that block a further movement of the gearbox.

These requirements are valid for a ship speed of 18 knots. For speeds above that, propeller noise will be dominant.

### Manufacturing

The production of the gear casing is an important part of building the total gear system. The casing itself is fairly large and complex with a total weight of 28 tons. The welding process is monitored to maintain constant quality in the welding and dimensions. After welding, the different parts are partly machined. The casing is assembled and the bearing seats are premachined. The final machining of the gear casing, an essential operation by which the center distance of the several shaft lines are machined within narrow limits, is done in a temperature controlled production shop. The precision of this part, achieving optimal alignment between the shaft lines, is an important aspect of low noise design. All rotating elements are ground to a Class 3 quality, ISO 1328. The tooth contact pattern of all interacting gears are checked before they are released for final assembly. All stages in the production of the gears are followed and recorded with regard to the important parameters of each specific stage. Balancing is done separately for each component and partly in the assembled position.

The assembly of the casing with the rotating elements and oil system is the last control to see if all the required tolerances are really matched. During the assembly, dimensions are always carefully checked.

### Test Conditions

All gears are submitted to spin and partial load tests. The spin test demonstrates the functional performance of the gear and verifies the stability of the bearing temperatures, the electric system and the functioning clutches. The partial load test demonstrates the performance of the gear with regard to noise requirements. The loaded test is done in a back-to-back test arrangement as shown in Figure 9. The structure-borne and airborne noise of this gearbox requires this back-to-back test configuration for both diesel and gas turbine drive modes at the power ratings for a ship speed of 18 knots. The tests were performed for an equivalent power of 3,000 kW.

The acceptance of the gears required absolute certainty about the performance of structural and airborne noise levels because a possible deviation from the expected data can be corrected better in



the factory than it can in the built-in situation aboard the ship. The different test conditions during the back-to-back test are listed in Table 3.

Building the test rig was something new for the engineers at Schelde Gears. Because of this, the influence of each part of the test rig needed to be evaluated, as direct experience with this type of test rig was not directly available. Each component in the test rig, as well as the gear itself, could influence the test results in either a positive or negative way. Therefore, the first objective was to recognize those parameters of influence and eliminate them as much as possible.

In the back-to-back configuration, the main shafts are coupled. Then, depending on the test mode, either the diesel input shaft or the gas turbine input shaft is also coupled to drive the slave gearbox (see Figure 8).

The gears were mounted on a resilient mounting like those designed for the ship's foundation during all the tests. The alignment of the gearboxes in the back-to-back test needed special attention because the bearing loads had to be about equal to the loads expected under operational conditions. This required different alignment procedures for the diesel and gas turbine engines. The main concern for this part is the flexibility of the main shaft line. In this shaft line, torsional stiffness needed to be combined with a certain degree of bending flexibility in order to maintain the proper bearing load division on the main bearings.

The input shafts were connected to the torque actuator with flexible couplings on the intermediate shafts. The weight of the intermediate shafts was limited in order to realize a bearing load distribution that is equal to that in reality. The balancing and alignment of all those parts is of significant influence on the test results. Some of those results are presented in Figure 10.

During the back-to-back test, the gear driven pumps supplied the lubricating oil to the gear components. The skid with all the oil equipment is placed close to the test bed. The test conditions for the gear were to be close to normal operational conditions.

The tooth load is generated with a torque actuator. This torque actuator is designed for a torque of 45 kN at a maximum speed of 3,500 RPM. This actuator is designed and built by the Design Unit from the University of Newcastle. The concept of this design has been presented in Ref. 2. The tooth load is adapted in accordance with the output shaft load curve of the gear during operation.

The torque actuator is a vane-type coupling, which enables the torque to be changed during running. The actuator is mounted between the interme-

mediate shafts. Although the shafts had flexible couplings, the influence of the alignment and stiffness of the actuator foundation was considerable. From the actuator, a constant peak of one times the shaft speed influenced the measurements. Improvements of the foundation stiffness and the shaft balancing improved the results. Therefore, the flexible couplings were balanced in their mounted position. The shafts were well balanced, but tests showed that the flexible part in the shaft had a negative influence on the measurements. Balancing the hubs at the primary and secondary sides of the flexible elements of the coupling showed improvement. The shaft orbit was changed from a diameter of approximately 50 microns to less than 10 microns.

The oil pump characteristics also had a great influence on the results. This influence was clearly shown in the frequency area of 60 to 400 Hz and was greatly alleviated by improving the pump design. The pulsation in the oil flow and the stiffness of the pump foundation was shown to have a considerable influence on the vibration levels of the gear. Both of these aspects were improved during the testing phase. The tests for the diesel propulsion mode were influenced by the internal alignment in the multiplate friction-type clutch. Due to the low engaging energy required for this test, special engaging procedures were used for better plate alignment. In Figure 10, the achieved level of vibration is given.

**Results.** The results of the tests show that the requirements of the specification were met. The realization of the test rig required a careful setup, alignment and local balancing. Above the mountings, the required values are met. At higher frequencies, the line is even below the specification. Each component mounted on the gearbox has its own contribution to the vibration spectrum.

### Conclusions

The design of low noise gears requires careful attention for all components, not only for design but also during the manufacturing process. This is in respect to the gear elements and to all rotating equipment that is mounted on the gearbox, e.g. gear-driven pumps.

The back-to-back testing of a gear can only be successful and representative when all operational conditions can be reproduced. This is valid, especially for the balancing of all shafts and couplings, especially for the high-speed shafts. The engagement sequences should be as close as possible to the conditions on board the ship. In case these conditions are not met, the result will give an approximation, but will be contaminated with disturbances from the test rig. ◉

### References

1. A New Rotary Torque Actuator for High Rotational Speeds. J. Rosinski, J. Haigh and D.A. Hofman. 1994 International Gearing Conference, Newcastle, UK.
2. Development of a New Three-Dimensional Mode of Helical Gears. J.J. Burdess, J. Pennell and J. Rosinski. 1994 International Gearing Conference, Newcastle, UK.
3. High Performance Gearing for Modern Naval Gas Turbine Propulsion Systems. J.B. Kerpenstein. 1987 ASME Gas Turbine Conference, ASME Paper 87-GT-247.

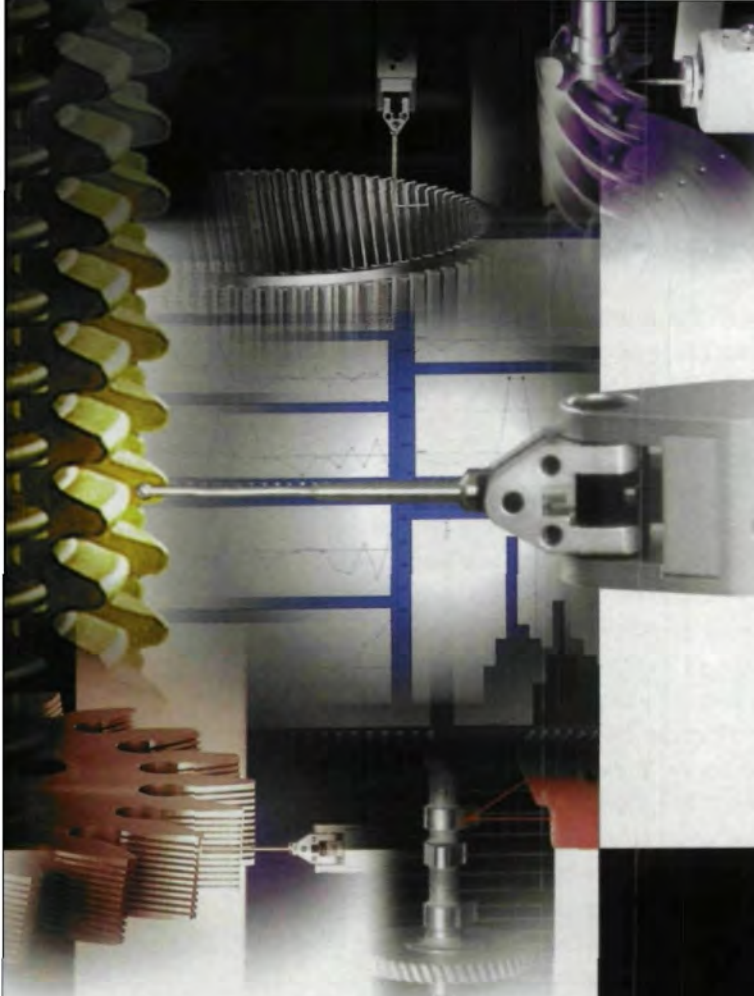
### Tell Us What You Think . . .

If you found this article of interest and/or useful, please circle 257.

If you did not care for this article, circle 258.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618.





**M & M Solutions ...**

**Worm and Worm Gears**

**The  
Simple  
Solution  
To Right Angle  
Gear Analysis**

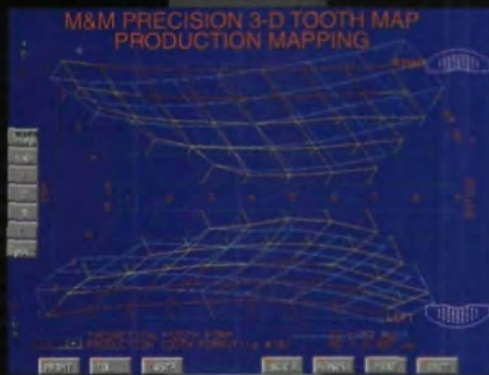
**With M&M, A,N,I and K-type worm and worm gear inspection and analysis is not only easy, it also lowers your development cost and reduces set-up time on every job.**

**Multiple Inspection Methods:** Measure against theoretical forms based on an easy-to-use cutting simulation. Or compare to a master artifact automatically scanned by your M&M Gear Inspection System. You can even inspect from your own coordinate files.

**Process Simulation:** "Virtual cutting" lets you see the effect of machine tool settings on your PC and make corrections *before* you begin cutting.

**No Programming Required:** All you need are M&M's tailored, application-specific software and correction modules to meet your inspection, analysis and process control needs. (Be sure to ask about M&M's straight and spiral bevel and hypoid gear packages, too.)

**To talk with one of our experts,** please call: (937) 859-8273. Or fax: (937) 859-4452; e-mail: [info@mmprecision.com](mailto:info@mmprecision.com). Visit us on the web at [www.mmprecision.com](http://www.mmprecision.com).



**M&M PRECISION SYSTEMS CORPORATION**

"THE METROLOGY & MOTION PEOPLE"®

© 1999 M&M Precision Systems Corporation

CIRCLE 165



# A Practical Guide for Molding Better Plastic Geared Transmissions

Roderick E. Kleiss & Jack Kleiss Jr.

## Abstract

Plastic gears and transmissions require a different design approach than metal transmissions. Different tools are available to the plastic transmission designer for optimizing his geared product, and different requirements exist for inspection and testing.

This paper will present some of the new technology available to the plastic gear user, including design, mold construction, inspection, and testing of plastic gears and transmissions.

## Comparing Plastic to Metal

One of the most profound differences between a molded plastic gear and its metal counterpart is the way it is made. Almost all metal gears are cut. Plastic gears are molded. The few metal gears that are not cut, i.e. powder metal and forged gears, require approaches very similar to the ones outlined here for plastic. In many ways plastic gear manufacturers are leading the industry into new levels of accuracy, design freedom and total gear inspection. With wire EDM, spur gear cavities can be cut with accuracies to 100  $\mu$ -inches. However, since this is a non-generative process, cutting errors can occur anywhere. Therefore, the entire pattern of the internal gear cavity must be inspected rather than just a few representative teeth as is usually done with metal gears. Just setting up cavities and plastic gears on inspection equipment designed for metal gears can be daunting. The molded plastic gears must also be inspected over the entire pattern since shrinkage abnormalities and molding anomalies can occur at any location. The advantage of molded gears is that any specific gear that can be

drawn in CAD can usually be molded. The challenge is to measure and adjust the molded gear for its unique shrinkage and molding anomalies. Metal gear applications might someday benefit from this type of full profile inspection and comparison to the generative process.

There are other differences between plastic and metal gears. Some of these differences are due to their different methods of manufacturing. Since metal gears are cut or ground to shape, they can be expected to have highly concentric features due to the turning operation. Precision diameters are not too difficult to maintain. Shrinkage compensation is not required in their manufacture.

Plastic gears are molded. Concentricity of the bore to the tooth geometry is one of the most difficult features to maintain. Tooth geometry itself can be more precise than the average metal gear since a wire EDM generated gear cavity is inherently more accurate than a cavity made with a hob-cut electrode (Ref. 1). Also, engineering plastics tend to have high but very consistent and repeatable shrink from that cavity. This shrinkage must always be considered and compensated for in molded plastic. Diameter tolerances will almost always be greater for plastic gears than for metal.

Plastic materials are much weaker than metal, but they also have strengths not found in metal. Built in lubrication, ultralight weight, low noise, and low cost, are all attributes of molded plastic gears.

These fundamental differences confound the traditional logic for gear design and manufacture. Gear tolerances and ratings are based on metal gear construction. These standards are not ideally



Fig. 1—A spur gear being cut by wire EDM.

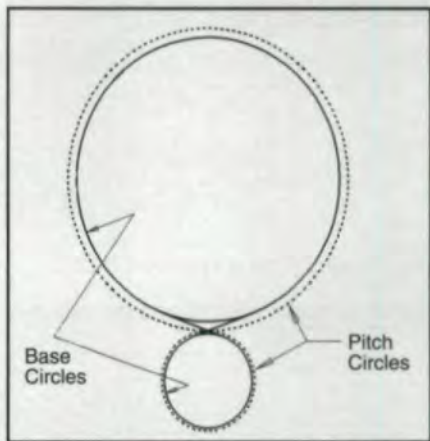


Fig. 2—Involute geared transmissions are ideally equivalent to crossed-axis belt drives.

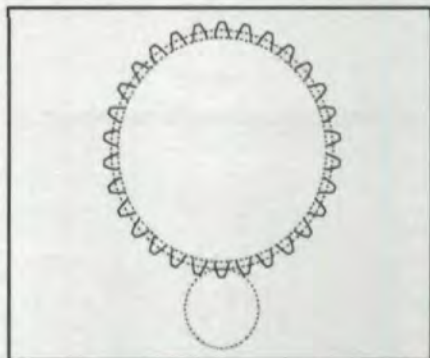


Fig. 3—Defining the tooth thickness and drawing the involute form.



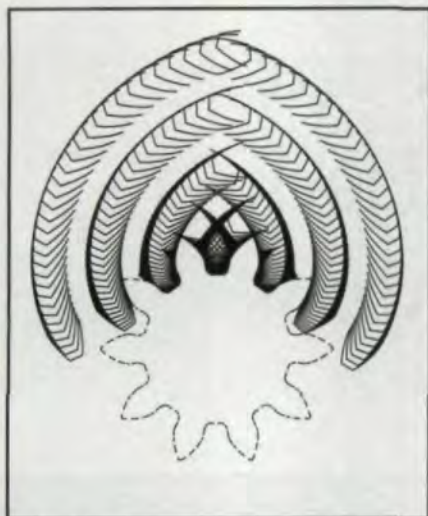


Fig. 4—A partially constructed gear is rotated about the pitch circle of its mate to form the outline of the mate.

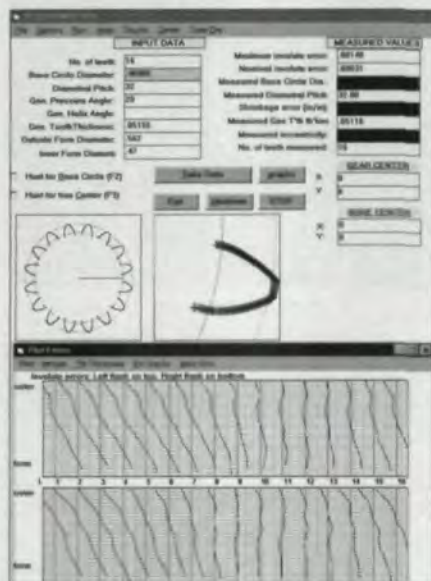


Fig. 5—Best fit inspection results.

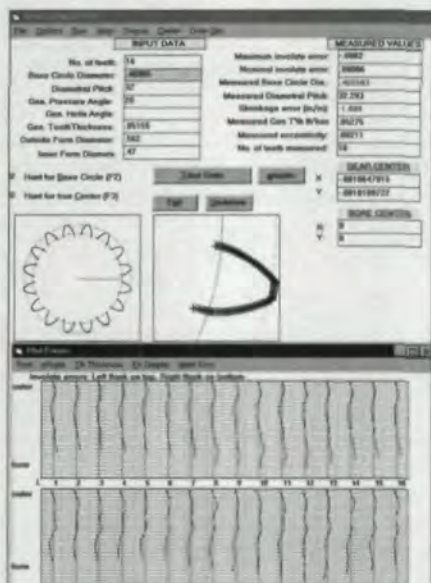


Fig. 6—Best fit inspection results, compensating for shrinkage error.

descriptive of plastic gear geometry. Design calculations are based on metal material properties and do not accurately predict plastic gear function and life. Even the plastic material properties supplied by resin vendors do not accurately define the real material parameters of a plastic gear as it is moving into and out of mesh at a high rate of speed. Traditional plastic properties are based on long term phenomena.

### Designing Plastic Gears

Customarily, metal gears are designed and defined with respect to their cutting process by the basic rack method, and many plastic gear designers use a similar approach. The defined pitch circle of a metal gear describes the set-up distance with the gear to its cutting tool. Such things as addendum modification refer to additional cutting tool set-up features required to produce the desired gear shape. The 'whole depth' of a gear really refers to how far the cutter plunges into the gear blank. However, in plastics we don't need this definition scheme, and many times it only causes confusion and misinterpretation.

A great benefit of the basic rack method is that it allows families of gears to be cut that will all mesh properly with each other in any combination. However, plastic gears are usually designed for specific high-volume applications. We are trying to make as rugged a gear set as we can; therefore we waste no time trying to make these gears generally suitable for a range of applications. The approach outlined below is a method for maximizing the function for a specific transmission.

Almost all plastic spur gears these days are molded from cavities cut with wire Electrical Discharge Machining (EDM) as pictured in Figure 1. Kleiss and Hoffmann (Ref. 1) have written on the process, its application, and its accuracy. Wire EDM can trace any two-dimensional construction directly from a Computer Aided Drawing (CAD) file to a machined part. Therefore, any geometry that can be represented in CAD can essentially be applied to the mold cavity.

The importance of this difference is profound. Plastic gears are not depen-

dent on metal gear tooling to create their geometry. The gear designer is free to create the perfect mathematical gear on paper and transfer that geometry to the gear through wire EDM. One method of doing this is to let the gears essentially design themselves through their meshing conditions.

Involute geared transmissions are ideally equivalent to the crossed-axis belt drives in Figure 2. The gear teeth cause the same rotational effect using the same path of transmission. The driver pushes the driven through the path defined by the belt coming off one drum or base circle, crossing the pitch point and moving to the base circle of the other drum. Many of the features of the crossed belt drive are exactly described with gear nomenclature such as base circle, pitch circle, pressure angle, and base tangent length. Khiralla (Ref. 2) thoroughly describes this geometry of motion as well as the mathematical construction of the involute.

With these facts in hand, one can relatively size the drums per the reduction ratio of the intended gear set. Absolute size is unimportant at this stage since the final gears can be scaled to fit the intended volume. Next, the designer must select a base tooth thickness and draw the involute tooth form on one gear, as shown in Figure 3, as well as the distance to separate the gears, which will fix the working pressure angle. The outside diameter of the gear is set arbitrarily at this point.

Now that one gear has been defined in the above fashion, the rest of the construction will be self-generating. The partially constructed gear is rotated about the pitch circle of its mate, and the outline of its mate is formed as in Figure 4. The tip of that gear is cut off at a reasonable length and then the second gear is in turn rotated about the pitch circle of the first to outline the root of that gear. With this complete, the two gears are fully described at their maximum material condition. In order to account for eccentricity and molded tolerances, the teeth can be additionally thinned, or the gears can be pulled slightly apart to allow for necessary clearance. The outside diameters can



be tolerated minus from this maximum material condition to eliminate the possibility of interference.

This self-generating construction technique allows the designer to maximize the gear action for the plastic mesh. Teeth can be made longer to increase the working range of engagement or thicker to increase tooth strength. Attention must still be paid to traditional gear concerns such as contact ratio and tooth strength. Khiralla and Colbourne (Ref. 3) describe mathematics for these calculations, although very little practical validation of tooth strength mathematics exists for plastic gear teeth.

A further advantage of this technique is that the CAD geometry can be used to compare molded gear features either optically or with a scanning Coordinate Measuring Machine (CMM).

#### Plastic Gear Shrinkage

The next critical step in plastic gear manufacture is mold development. This requires estimating shrinkage for the plastic gear geometry, a feature that has caused many potentially acceptable plastic transmissions to perform inadequately or fail. Kleiss (4) wrote about the effect of plastic gear shrinkage and thermal expansion. Since that paper, further work has shown the authors that it is definitely incorrect to presume that plastic gears shrink isotropically, or in more common terms like a photographic reduction. The authors have found that plastic gear shrinkage is indeed much more fascinating.

There are two aspects of plastic gear shrinkage, macroscopic and local. The body and major features of a simple symmetrical plastic gear will have one approximate shrinkage value. This would include such features as the outer diameter, root diameter, base, and pitch circles. Local shrinkage around the individual gear tooth has a totally different shrink rate. The major effect of these differing shrink rates is that tooth thickness does not shrink nearly as much as other gear features. In some cases, it can actually expand from the mold due to local effects. This is most profound in unfilled crystalline materials such as acetal and nylon.



## The Great Geardini Makes Burrs Vanish Before Your Eyes!

Of course, there's not really a magical way to handle your deburring needs, but we have the next best thing. OLS builds turnkey systems with proven performance. We've become the industry leader by offering the best overall value:

- High-speed, high-quality systems
- Quality components from brand-name manufacturers
- A variety of standard base models which can be adapted easily to your needs
- Engineered solutions for practically any application
- Trained staff of experts waiting to assist you



OLS Model 1200



**Call OLS today. We'll  
make your deburring  
troubles disappear!**

# OLS

On-Line Services

On-Line Services, Inc.  
1231 West Bagley Road  
Berea, Ohio 44017  
(440) 243-6251  
[www.olsmachine.com](http://www.olsmachine.com)

CIRCLE 144



## LeCOUNT

### EXPANDING MANDRELS

**WANTED?**  
**MORE ACCURACY**  
**MORE EXPANSION**  
**MORE VERSATILITY**  
**LONGER LIFE**  
**AND LESS COST?**



**THE ANSWER FOR 150 YEARS.**

**LeCOUNT, Inc.**

12 Dewitt Dr. • PO Box 950 • White River Jct., VT 05001 U.S.A.

Tel: (800) 642-6713 or (802) 296-2200 • Fax: (802) 296-6843 E-mail: [lecount@sover.net](mailto:lecount@sover.net)

Website: <http://www.sover.net/~lecount/> (includes product specifications)

CIRCLE 142



## Inspection

Due to the non-uniform shrinkage phenomenon of plastic gears, traditional inspection techniques fail. One cannot simply measure the major diameter of the molded gear to determine shrinkage and then roll-test the gear against a master gear to ascertain form. The entire gear must be inspected for its actual material condition. One possible method is to scan the entire involute geometry and perform a best fit of that geometry

to the intended shape as shown in Figure 5. The traces in this figure are representations of tooth form errors with respect to perfect geometry. The general trend of the negative slope indicates shrinkage error, while the slope variation of the traces around the gear indicate gear eccentricity. These effects are compensated for in Figure 6, showing the gear to have significant runout with a shrinkage error of .009 inches per inch. The tooth thickness of the measured gear is also

much larger than specified.

The plastic gear user can perform an inspection very similar to the one shown by comparing the molded gear geometry to the CAD geometry developed in the design phase. Once this shrinkage has been correctly accounted for, simple gear roll testing with a known master can be used to maintain quality and form in the production environment.

## Testing

The authors' personal experience indicates that no matter how thoroughly the components of a plastic transmission are designed and measured (cases, gears and shafts), it is impossible to predict plastic geared transmission torque capacity, smoothness, noise and life expectancy without actually testing the assembled transmission. The best way to conduct this functional test is by using a transmission dynamometer that directly measures input and output shaft torques and angular position/velocity. It is also beneficial to instrument the transmission case with an accelerometer. Spectral analysis of the input and output torques and/or velocities will reveal poor tooth geometry, while a spectral analysis of the accelerometer data will reveal poor



# REM<sup>®</sup> PROCESS

- ELIMINATE WEAR
- REDUCE NOISE
- INCREASE POWER DENSITY

Regardless of how fine you machine, grind, hob, or shave your gears, the final surface finish is a series of parallel peaks and valleys. During operation, these peaks produce metal-to-metal contacts. These metal-to-metal contacts result in the peaks being ground or broken off, producing the first generation of tooth pitting. Studies have shown that once tooth pitting begins, it will continue until ultimately the gear teeth fail.

The REM<sup>®</sup> Process, specifically used in finishing gears, will produce peak-free finishes in the 1 microinch range. This finish will eliminate metal-to-metal contact pitting, resulting in increased wear life and reduction in noise.

The REM<sup>®</sup> Process results in enhanced EHL lubricant films, allowing for lower operating temperatures and reduced torque. This combination of increased durability, reduced noise, and enhanced EHL lubricant films has permitted increases in power densities without increases in size.

The REM<sup>®</sup> Process has allowed for mechanical system upgrades without the need for costly and time-consuming redesign programs.

**Let REM demonstrate this Process on your components. Call for additional information and a product brochure.**

**Rem**  
CHEMICALS, INC.  
METAL FINISHING SPECIALISTS

325 West Queen Street, Southington, CT 06489 U.S.A.  
TEL: (860) 621-6755 • FAX: (860) 621-8822

2107 Longwood Drive, Brenham, TX 77833 U.S.A.  
TEL: (979) 277-9703 • FAX: (979) 277-0309

REM (Europe)  
5 Stockton End, Sandy, Bedfordshire, England SG 19 1RY  
TEL: 00 44 1767 691592 • FAX: 00 44 1767 69 1599

Website: [www.remchem.com](http://www.remchem.com)

See us at GPC 2000 Booth #527

© 2000, REM Chemicals, Inc.



Fig. 7—A simple dynamometer for testing transmissions.




Fig. 8—Transmission testing device with computer controlled air cylinder and load cell.



tooth geometry and indicate the vibratory power available to generate noise. A comparison of the input to output power (transmission efficiency) will find misaligned shafts, gears that are jamming due to oversizing or miscut roots, and incorrectly identified material among other deficiencies

The dimensions of plastic parts are subject to subtle changes during production. For example, mold cleaning and recutting, changes in molding compounds and/or process can cause these changes.

The authors have found it beneficial to periodically test production units of transmissions on a dynamometer. By comparing the dynamometer "signatures" of production units with the development units, they have detected significant changes in part geometry that component inspection missed.

Transmission dynamometers can be simple or complex. Many transmissions are DC motor powered. DC motor current is a good indicator of torque, and back EMF wave shape can indicate speed. By gearing a second motor to the output, a complete simple dyno test can be configured. Figure 7 shows an example of this kind of tester. An accelerometer was also used. This test found an interfering root geometry condition that component testing missed. A complex tester is shown in Figure 8. It consists of a computer controlled air cylinder and load cell that applies an arbitrary load function to a slider crank transmission. This tester found that the torque capacity of an existing transmission was considerably less than believed. 

#### References

1. Kleiss & Hoffmann, "The Generation of Precision Spur Gears Through Wire Electrical Discharge Machining." AGMA Technical Paper 93FTM12.
2. Khiralla, T.W. *On The Geometry of External Involute Spur Gears*. ISBN 0-9601752-1-0.
3. Colbourne, J.R. *The Geometry of Involute Gears*. ISBN 3-540-96522-X.
4. Kleiss, R.E. "The Effect of Thermal Shrink and Expansion on Plastic Gear Geometry." AGMA Technical Paper 91FTM14.

#### N. Jack Kleiss Jr.

*of Kleiss Engineering develops unique interactive gear design, analysis and testing systems for custom gear applications.*

#### Rod Kleiss

*of Kleiss Gears designs, molds and inspects custom gears and transmissions. Rod and Jack are working together to develop improved designs and gears for molded applications.*

#### Tell Us What You Think . . .

If you'd like more information on Kleiss Gears, please circle 259.

If you found this article of interest and/or useful, please circle 260.

If you did not care for this article, circle 261.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).

## SHIFT INTO HIGH GEAR

### CNC Spline Roller

- Precision Splines to AGMA Class Q12
- 5 to 7 CNC Axes
- Quick Change Over
- Wide Flexibility
- Up to 3 Different Splines in one Set-Up
- Rolls Through-Hardened Steel and Hollow Shafts



#### ERNST GROB AG

##### Cold-forming machines

CH-8708 Männedorf/Switzerland

Phone +41-1-922 77 00

Fax +41-1-922 77 88

Internet: <http://www.ernst-grob.com>

E-mail: [info@ernst-grob.com](mailto:info@ernst-grob.com)

#### Caledonian Midwest Sales, Inc.

5497 Daniel Drive • Brighton, MI 48114-9069

Phone (810) 227-3977 • Fax (810) 227-4771

E-mail: [dempster@ismi.net](mailto:dempster@ismi.net)

CIRCLE 111



# A Modular Approach to Computing Spiral Bevel Gears and Curvic Couplings

Dr. Hartmuth Mueller, Dr. Dieter Wiener, Dr. Roland Dutschk

**O**n general, bevel gears and curvic couplings are completely different elements. Bevel gears rotate on nonintersecting axes with a ratio based on the number of teeth. Curvic couplings work like a clutch (Fig. 1).

Computing these different elements in the same manner is based on the idea that curvic couplings are actually a special kind of plunge-cut spiral bevel ring gear with a pitch angle of  $90^\circ$ , a spiral angle close to  $0^\circ$  and a constant tooth depth. This principle allows curvic couplings to be computed like spiral bevel gears.

## The Motion Concept

Nearly all gearing systems are based on the idea of making teeth by generating the tooth with a tool that has a straight profile. This allows smooth motion for both the tool and the workpiece. A straight rack is used to make cylindrical gears. The workpiece constantly rotates while the rack moves linearly at a constant speed.



Fig. 1—Spiral bevel gears and Curvic Couplings.

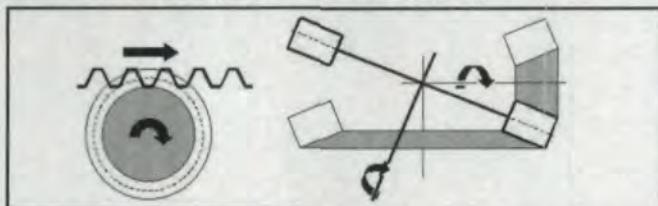


Fig. 2—Rack and plane gear.

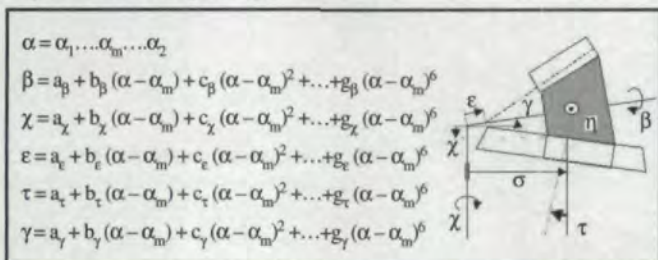


Fig. 3—Taylor approach for motion concept.

Bevel gears are made using a plane gear instead of a rack. The plane gear has a straight tooth profile, and the workpiece and the tool rotate constantly according to their number of teeth (Fig. 2).

The existing spiral bevel gearing systems mainly differ in the tooth lengthwise form. Typical Klingelnberg or Oerlikon gears have an epicycloidal lengthwise shape and constant depth. Typical Gleason gears have tapered depth and an arc in the lengthwise direction. The Palloid system creates gears with an involute profile in the lengthwise direction and constant depth. The tooth lengthwise form is defined by the lengthwise shape of the tool's teeth. In the case of a Gleason gear type, the tool is a cutter with blades arranged in a circle. In the case of a Klingelnberg or Oerlikon design, the tool is a cutter with several blade groups interfering to adjacent gaps while cutting. The involute lengthwise form of a Palloid design is achieved using a tapered hob. Basically, the principle of generating with a straight tooth profile tool is similar.

For achieving modifications to the flank topography, additional motions are used along with those of the basic principle. The amount of these additional modifications is small in comparison to the basic motion. In order to allow for all possible motions between workpiece and tool, an effective nonrestricting mathematical approach for the kinematics of the tool and workpiece is needed.

The basic description of the motion is developed using a Taylor series. The independent variable is the rotation of the plane gear called a cradle. All other motions depend on the cradle angle  $\alpha$ , as shown in Figure 3. A Taylor series is easy to handle. The effect of higher order coefficients has a clear effect on flank topography. For optimizing a gear set, these coefficients are a very powerful tool affecting flank shape. Using several coefficients, the tendency toward oscillation becomes a severe disadvantage for a Taylor series. By finding a good compromise between real free-form motions and handy coefficients correlating to modifications on the flank shape, a new approach is introduced.

For user driven modifications, we keep the Taylor coefficients; for automatically driven modifications, we superimpose cubic splines. The motion concept is a Taylor series plus real free-form additions based on cubic splines  $S(x)$ .

The NeutralData approach (Fig. 4), a mathematical description of the relative motion between workpiece and tool, allows free-form capabilities to be combined with the well known Taylor coefficients. The classical way to do this is based on a conventional hypoid machine with the generating motion expressed by a



Taylor series up to order 4 for any of the axes. Basic settings introduced by Gleason use this approach. Since any relative motion of workpiece and tool can be described, this approach supports all existing spiral bevel gearing systems.

### The Modular Approach

In designing a software tool for computing spiral bevel gears and curvic couplings, the first step is to divide the task into several independent modules (Fig. 5). If a single algorithm has to match all topics in the computations, it will be impossible to make it user friendly and effective. The presented approach divides the task into several steps to be done one after the other.

Designing a gear set always starts with the basic data like outside diameter, number of teeth, offset, etc. The first step is to design the blank geometry and the initial settings for the motion of gear and tool. This basic geometry is then used to compute the load capacity according to standards like DIN or AGMA. The next step is to optimize the running behavior by modifying the tooth flank topography. The characteristic to be improved is the Ease-off, representing the minimum contact distance for meshing pinion and gear without motion error. While designing the Ease-off, the blank geometry is not touched. The effects of modifying the flank shape influence the stress behavior. This is not taken into account by DIN or AGMA standards and needs to be computed by either a Finite Element or Boundary Element approach performed after optimizing the flanks.

### Dimension Computation

Designing a spiral bevel gear set begins with defining the size of the gear set and its ratio. To make sure that the basic geometry will meet the load carrying capacity, standards like DIN or AGMA are used. Based on the load and the basic geometry standards, compute the safety coefficients. This approach makes sure that the size of the gear set is close to what it needs to be for the desired load carrying capacity. These standards are very reliable since they are calibrated by many test runs. The standards for calculating the load carrying capacity of curvic couplings have to consider that the teeth don't mesh.

The initial data on a gear set is either the basic geometry or the power to be transmitted. Starting with the basic geometry, the load carrying capacity can be analyzed by calculating the standards. Beginning with the load, the standards will come up with the size of the gear set. It is up to the design engineer to find a compromise between minimizing the gear size and maximizing the load carrying capacity. The result of the dimension computation is the blank geometry including all details of the tooth shape.

### Ease-Off Design

Designing an Ease-off is the most important task in computing spiral bevel gears. The Ease-off is a graphical representation of the crownings on the pinion and the ring gear. Mathematically, the Ease-off is computed by calculating the minimum distance while meshing the teeth according to the number of teeth on each component. Beside surface effects on the flank, the Ease-off contains all the information on the running behavior of the gear set. As a result, the contact pattern and the motion curve can be computed. Computing the Ease-off for curvic couplings is quite simple since the teeth don't mesh.

$$\alpha = \alpha_1 \dots \alpha_m \dots \alpha_2$$

$$\beta = a_\beta + b_\beta (\alpha - \alpha_m) + c_\beta (\alpha - \alpha_m)^2 + \dots + g_\beta (\alpha - \alpha_m)^6 + S_\beta(\alpha)$$

$$\chi = a_\chi + b_\chi (\alpha - \alpha_m) + c_\chi (\alpha - \alpha_m)^2 + \dots + g_\chi (\alpha - \alpha_m)^6 + S_\chi(\alpha)$$

$$\varepsilon = a_\varepsilon + b_\varepsilon (\alpha - \alpha_m) + c_\varepsilon (\alpha - \alpha_m)^2 + \dots + g_\varepsilon (\alpha - \alpha_m)^6 + S_\varepsilon(\alpha)$$

$$\tau = a_\tau + b_\tau (\alpha - \alpha_m) + c_\tau (\alpha - \alpha_m)^2 + \dots + g_\tau (\alpha - \alpha_m)^6 + S_\tau(\alpha)$$

$$\gamma = a_\gamma + b_\gamma (\alpha - \alpha_m) + c_\gamma (\alpha - \alpha_m)^2 + \dots + g_\gamma (\alpha - \alpha_m)^6 + S_\gamma(\alpha)$$

Fig. 4—NeutralData approach.

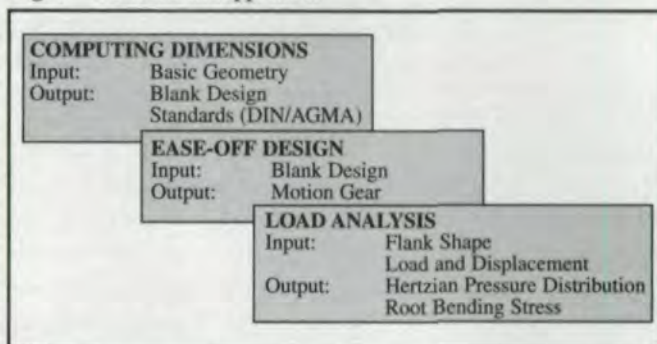


Fig. 5—Independent modules.

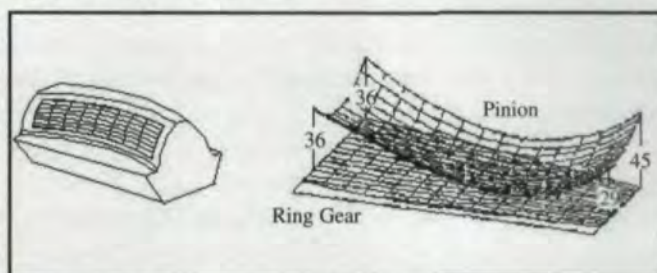


Fig. 6—Grid on the flank and Ease-off.

An Ease-off is computed based on a grid covering the pinion and ring gear teeth as shown in Figure 6. For every point on the ring gear's grid, the minimum contact distance to the meshing pinion's tooth is calculated and displayed graphically. To optimize the Ease-off, a numerical representation of the graph shown in Figure 6 is needed. The principle is to extract independent components having a clear influence to the contact pattern and to the motion curve.

Figure 7 shows the five basic components of an Ease-off. Profile crowning limits the contact pattern in its height and affects the angle between the contact path and the pitch line. Increasing the profile crowning makes the gear set less sensitive to deflections but increases the motion error. Lengthwise crowning changes the contact pattern length. With less lengthwise crowning, the gear set will run more smoothly. However, sensitivity to deflection will increase and the load carrying capacity will be spoiled.

Changing the pressure angle difference will move the contact in a vertical direction. Changing the spiral angle difference will move the pattern in a horizontal direction. The longitudinal twist changes the angle of the contact path, the so-called bias angle.

When designing the Ease-off, enter the numerical values of the crowning, angle difference and twist. The algorithm then changes the relative motion between workpiece and tool to achieve the desired Ease-off. Since there are many parameters in NeutralData affecting the motion, the program will ask the operator which parameter to use. Changing, for example, the spiral



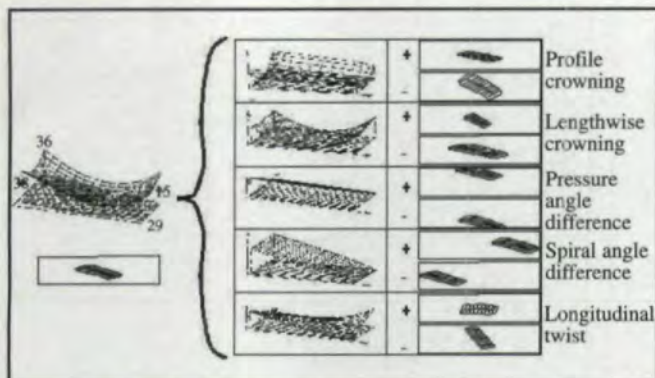


Fig. 7—Ease-off components.

angle difference can be done by modifying the Radial Distance  $\phi$  or by modifying the machine root angle  $\gamma$  (including a subsequent modification of the Sliding Base  $\chi$ ) or by changing the tool's inclination defined by the Tilt  $\tau$  and the Swivel  $\sigma$ . For some applications there are restrictions in the root angle, which is not allowed to be changed even by a very small amount. If the user does not have a chance to enable or disable parameters for optimization, the program is not usable. The selection of the parameters to be used is a compromise between an operator driven approach and a fully automatic approach that does not permit user intervention.

The Ease-off optimization changes the motion between workpiece and tool without affecting the blank geometry. Nothing related to dimension computation is changed by this procedure.

## Load Analysis

The Load Analysis is the most time consuming part of the software package. A rough assumption on the load carrying capacity is performed during load analysis. At this moment, only the size of the gear and its basic geometry are used for computing the safety coefficients that tell the operator whether or not the gear size is good.

Computing the stress behavior with the theoretical shape of the flank is a very precise tool. The characteristics of the Ease-off are taken into account, and experience with a lot of gear sets shows the potential benefits of this approach.


Based on the deflection, the torque and the flank shape, a calculation is made to compute the deflection of the teeth under load. One of the results is the Hertzian pressure distribution. Depending on the load, the growth of the contact pattern could rise with peaks in the pressure when the contact extends to the edge of the teeth. The maximum pressure will be very high in these areas. If this result occurs, the profile crowning needs to be increased. This will increase the average level of the pressure, but since the contact will not extend to the edge, the maximum pressure can be decreased. This effect can be demonstrated by optimizing the design of a passenger car gear set.

In Figure 9, the Ease-off, contact pattern and motion curve are shown. The Ease-off has a strong lengthwise crowning and zero profile crowning. The contact path is very steep while the transmission error is about 31  $\mu$ rad.

# HURTH MODUL

## Innovative technology for GEAR HOBBING and BEVEL GEAR CUTTING

CNC actuation and reduced set-up times characterize the HURTH MODUL machines, engineered with German precision. Designed to be flexible for a variety of cutting methods while enduring rugged usage, compact HURTH MODUL machines offer optional automation with CNC-controlled digital drives. Call today for details.

 American  
**Wera** Inc.  
Sales & Service

4630 Freedom Drive • Ann Arbor, MI 48108  
734.973.7800 • Fax: 734.973.3053  
www.american-wera.com





**Redefining “Worldclass” for a new millennium.**

*The world is quickly beginning to realize that the essence of MACSTEEL® is quality and service. Our capacity for engineered steel bars has grown dramatically along with a host of value-added services such as commercial heat treating and the patented Nitrotec treatment of our new NitroSteel bars. Our goal, as we move into the next millennium, is to continue our extraordinary growth while maintaining our #1 position in quality and service.*

1-800-876-7833

<http://www.macsteel.com>

**MACSTEEL®**





**GEAR MACHINES**



**Model GH32-11**  
**High Production**  
**Gear Hobber**  
**\$ 59,395**  
**32" Diameter**  
**11" or 19" Face**

**Model GS10-3HS**  
**High Precision**  
**Gear Sharper**  
**\$64,795**  
**10" Diameter**



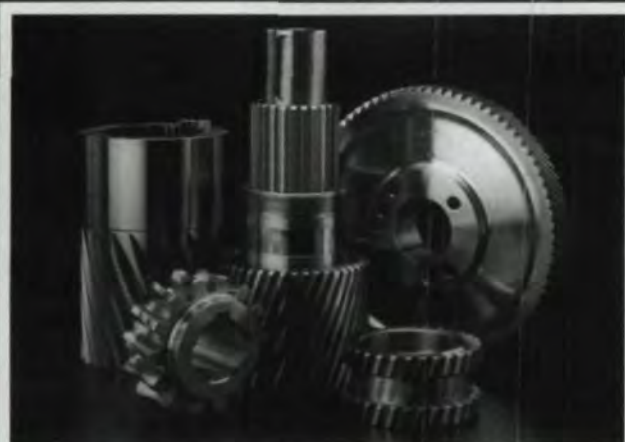
Visit our web site: [www.basicmachinetools.com](http://www.basicmachinetools.com)

NATIONAL DISTRIBUTOR

**BASIC INCORPORATED GROUP**

Email: [wolf@basicmachinetools.com](mailto:wolf@basicmachinetools.com)  
 Telephone: (323) 933-7191  
 Fax: (323) 933-7487  
 P.O. Box 36276, Los Angeles, CA 90036

CIRCLE 146



**GROUND GEARS – Ten or Ten Thousand**

For small to medium quantities of spurs or helicals that have to meet close-tolerance AGMA or DIN specs, our Reishauer grinders and M&M gear analysis systems are the perfect combination.

For Long runs, we offer the unique Liebherr CBN grinding process with full SPC quality control and documentation.

So whether your needs are for ten or tens of thousands, we invite you to join the growing list of INSCO customers who rely on us for consistent quality, reasonable costs, and reliable delivery.



412 Main Street, Groton, Massachusetts 01450

PHONE: 978-448-6368  
 FAX: 978-448-5155  
 WEB: [insecorp.com](http://insecorp.com)

ISO 9001 Registered

CIRCLE 148

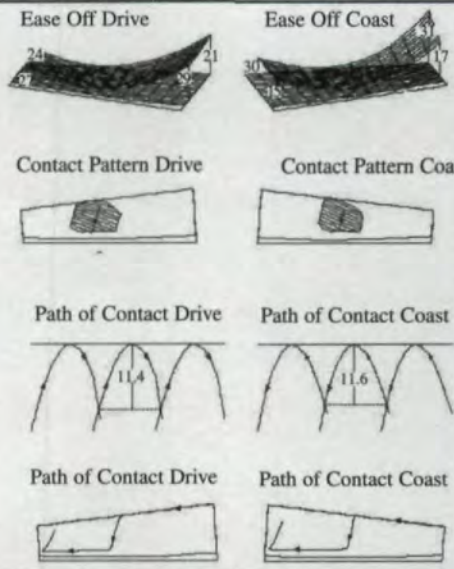


Fig. 8—Pressure distribution and root bending stress example 1 (Drive Side).

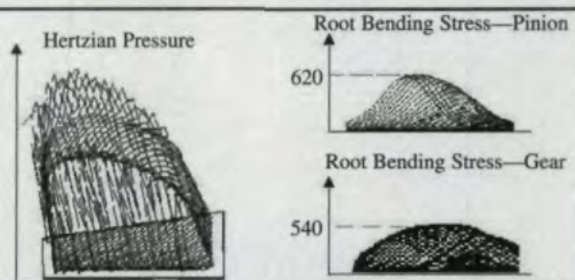


Fig. 9—Pressure distribution and root bending stress example 1 (Drive Side).

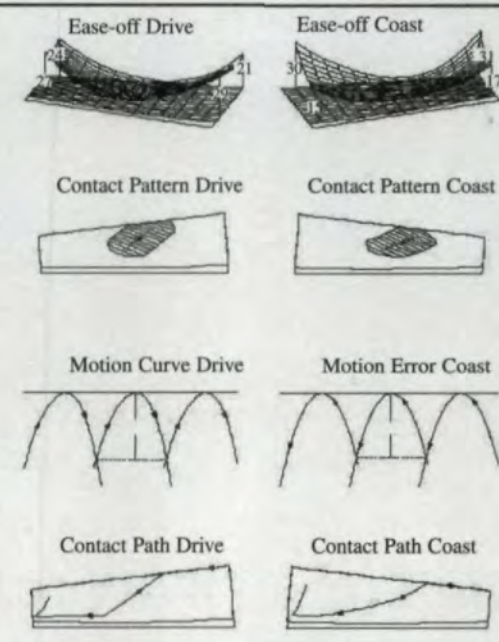


Fig. 10—Design example 2.

The result of the stress analysis on the drive side using a boundary element approach is seen in Figure 10. Since the contact extends to the tooth edge, the maximum pressure is given by the peaks. The maximum value of the pressure is 2120 N/mm<sup>2</sup>. The root bending stress on the pinion is 620 N/mm<sup>2</sup>. The root bending stress on the gear is 540 N/mm<sup>2</sup>.



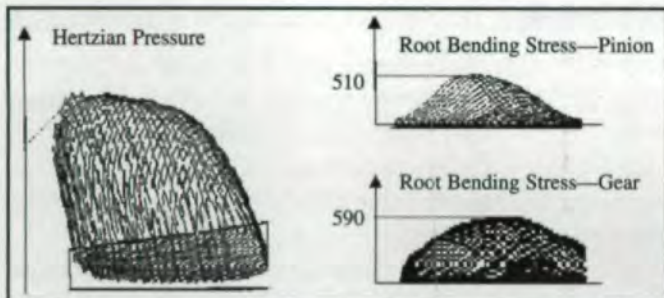


Fig. 11—Pressure distribution and root bending stress example 2.

In Figure 8, the same gear set is shown, but the Ease-off is optimized. Profile crowning was increased, the lengthwise crowning was reduced and a longitudinal twist was introduced. The contact pattern now has a bias angle, and the transmission error is less than  $10 \mu$  rad. This design is superior in noise behavior.

The results of the stress computation are shown in Figure 11. By increasing the profile crowning, the maximum of the Hertzian pressure can be reduced to  $1890 \text{ N/mm}^2$ , since the contact doesn't extend to the edge of the teeth. More surprising is the reduction of the root bending stress on the pinion to  $510 \text{ N/mm}^2$ .

The reduction in the pinion root bending stress is due to the Hertzian pressure distribution. In Figure 9, the maximum pressure was on the top of the pinion tooth far from the tooth root. In Figure 10, the maximum of the pressure distribution is in the center and closer to the root. The distance between the tooth root and the position on the tooth flank where the force is loaded affects the bending stress drastically. ☉

*Curvic Coupling* is a registered trademark of the Gleason Corporation.

*This paper was first presented at the Fourth World Congress on Gearing and Power Transmission in Paris, France, March 1999.*

#### Dr. Hartmuth Mueller

is the Chief Engineer for Research and Development for the Klingelberg Soehne Technical Center in Ettlingen, Germany. He studied electrical engineering at the Technical University of Karlsruhe, where his thesis related to multilayer routing algorithms. He has led the Bevel Gear Working Group of the FVA, a research association covering driving technology.

#### Dr. Dieter Wiener

is the Managing Director responsible for Research and Development at Klingelberg. He studied mechanical engineering at the Technical University of Aachen and wrote his thesis on the load carrying capacity of spiral bevel gears.

#### Dr. Roland Dutschak

studied mathematics at the State University of Odessa. Later he joined the Technical University of Dresden to perform research work. While there, he wrote a thesis about the geometrical problems in the manufacturing and meshing of spiral bevel gears. He has worked at Klingelberg since 1995.

#### Tell Us What You Think . . .

If you found this article of interest and/or useful, please circle 262.

If you did not care for this article, circle 263.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).

## ASANO GEAR CO., LTD.

*Gear Specialists Serving Industries Worldwide*

Asano Gear has over 70 years of experience as a specialist in the manufacture of products ranging from high-precision transmission gears and engine gears to vehicle axles and speed-accelerating/decelerating gear assemblies.



#### Standard products:

- Four-wheel driving axles and axles for construction machinery
- Transmission gears
- Automotive vehicle engine gears
- Hypoid gears
- Low cost, high performance torque-sensing differentials
- Powerful, durable, high-performance planetary gear reducers
- High-efficiency continuously variable automatic transmissions



Sales Office: ASANO AMERICA, INC.

5555 Oakbrook Parkway, Suite 440, Norcross, GA 30093

Phone: (770) 449-0500 • Fax: (770) 209-0165

E-mail: [Asano@AsanoAmerica.com](mailto:Asano@AsanoAmerica.com) • Website: [www.AsanoAmerica.com](http://www.AsanoAmerica.com)

*Our corporate goal is ongoing improvement of gear performance and the development of new products and technologies that deliver total customer satisfaction.*

CIRCLE 136

## Toolink Engineering

### NEW! Lightweight Hydraulic Arbor

#### Light as a Feather

Toolink Engineering offers hydraulic arbors made of a light metal alloy that weigh up to 70% less than a comparable steel arbor.

#### Highest Accuracy

Feather light hydraulic arbors can be manufactured with runout as low as 2 microns. The clamping sleeves are replaceable. This tooling is suitable for measuring, testing, balancing, gear grinding and other applications.



Toolink Engineering is the exclusive North American distributor of König mtm Work Holding Devices available for the following applications: • Gear Grinding • Gear Shaping • Gear Hobbing • Gear Shaving • Tool Grinding • Testing • I.D. - O.D. Grinding • Balancing • Turning • Milling.



Toolink Engineering  
2870 Wilderness Place  
Boulder, CO 80301  
PH 303.938.8570  
FAX 303.938.8572  
[www.toolink-eng.com](http://www.toolink-eng.com)

CIRCLE 208

MAY/JUNE 2000 37



# Fässler Direct Honing™

Fässler K-300 & K-400-A Gear Honing Machines



Honing of Automatic Transmission Ring Gear

Fast, economical hard gear finishing process that increases gear life while reducing or eliminating gear noise.

- Internal or external gears
- Spur, helical or cluster gears

With Direct Honing you can hob, heat treat and hone your gears to market requirements.

With Universal Honing it is possible to finish a family of gears having the same tooth characteristics with varying numbers of teeth.

With Combi-Honing you can rough and finish on the same machine with honing stones mounted in tandem.

#### CHARACTERISTICS OF HONED GEARS:

- Increased wear resistance
- High surface finish
- Favorable machining marks for noise reduction
- Low surface roughness guarantees a permanent oil film

## Fässler

Fässler Corporation  
131 W. Layton Avenue  
Suite 308  
Milwaukee, WI 53207  
Phone: (414) 769-0072  
Fax: (414) 769-8610  
E-mail: fassler@execpc.com

Fässler AG  
Ringstrasse 20  
CH-8600 Dübendorf  
Switzerland  
Phone: 011-411-802-35-21  
Fax: 011-411-802-35-99  
Web: www.faessler-ag.ch

**Fässler makes good gears better!**

CIRCLE 205

## TECHNICAL CALENDAR

**May 8-10. SME Gear Design and Heat Treating Programs.** Nashville, TN. The following programs are being sponsored by SME: The Preliminary Gear Design Thought Process (May 8), the SME Heat Treating Conference (May 8-12), and Advanced Gear Processing and Manufacturing (May 9-10). Call SME at (800) 733-4763 for details.

**May 10-12. The 9<sup>th</sup> International Induction Heating Seminar.** Hilton Clearwater Beach Resort, Clearwater, FL. Technical papers will be presented on a variety of new processes and developments in induction heating technology. For information, contact Inductoheat at (248) 585-9393.

**May 22-24. Fundamentals of Parallel Axis Gear Manufacturing.** Pheasant Run Resort, St. Charles, IL. Sponsored by Koepfer America, L.L.C., this course will present six speakers discussing basic and advanced gear manufacturing, inspection and technology. Tours of several area gear plants and equipment demonstrations are included. Call (847) 931-4121 for details.

**May 23-25. Eastec 2000 Advanced Productivity Exposition.** Eastern States Exposition Grounds, West Springfield, MA. Sponsored by SME, AMTDA and AMT, Eastec 2000 promises to be the East Coast's largest manufacturing exposition. There will be SME-sponsored technical courses on advanced manufacturing technologies and processes. For details log onto [www.sme.org](http://www.sme.org) or call (800) 733-4763, ext. 1600.

**May 30-June 3. The 2000 International Conference on Powder Metallurgy & Particulate Materials.** New York Hilton, New York, NY. Sponsored by MPIF and APMI International. A four-day event featuring over 250 technical presentations and a trade exhibition showing new materials, equipment and products. Contact MPIF at (609) 452-7700 or visit their Web site at [www.mpif.org](http://www.mpif.org).

**June 19-23. NPE 2000—The World's Plastic Showcase.** McCormick Place, Chicago, IL. Sponsored by SPI, NPE 2000 will have exhibits from over 2,000 companies from all over the world showing the latest in machines, materials and processes. More than 85,000 visitors are expected from over 100 countries. Call SPI at (202) 974-5235 or visit [www.npe.org](http://www.npe.org).

**June 26-30. AGMA Training School for Gear Manufacturing: Basic Course.** Richard J. Daley College, Chicago, IL. Five days of classroom and hands-on training in basic gearing, efficient machine set-up techniques, accurate gear inspection and gearing calculation. This course will be repeated September 11-15 and October 2-6. Call AGMA at (703) 684-0211 or visit [www.agma.org](http://www.agma.org).

#### Tell Us What You Think . . .

If you found this column of interest and/or useful, please circle 264.

If you did not care for this column, circle 265.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).





## Quieter Gears. Engineered Metals.

There's only one way to ensure that the gears you produce will always deliver superior and quiet performance. Make sure they're bred from quality stock.


Dura-Bar® continuous-cast gray and ductile iron performs like free-machining steel with an important added bonus – quieter operation.

Like steel, Dura-Bar can be austempered, through-hardened, flame-hardened, or induction-hardened for added wear resistance. But the superior noise and vibration damping characteristics of Dura-Bar make for quieter running gears. And Dura-Bar is 10% lighter than steel.

Dura-Bar round bars are available in diameters ranging from 5/8" to 20" and lengths of 6-20'. So you won't need to make major changes in your machining equipment. And our extensive inventory means Dura-Bar is available now – when you need it.

When it's quality material, quiet performance, and quick delivery that count, look to continuous-cast Dura-Bar for your gear production needs.



 **DURA-BAR®**  
Continuous Cast Iron Bar Stock

Contact us for the latest data on gear noise.

1-800-BAR-MILL (227-6455) • 815-338-7800 • Fax: 815-338-1549  
2100 West Lake Shore Drive, Woodstock, IL 60098-7497  
Web Site: [www.dura-bar.com](http://www.dura-bar.com) • E-mail: [sales@dura-bar.com](mailto:sales@dura-bar.com)

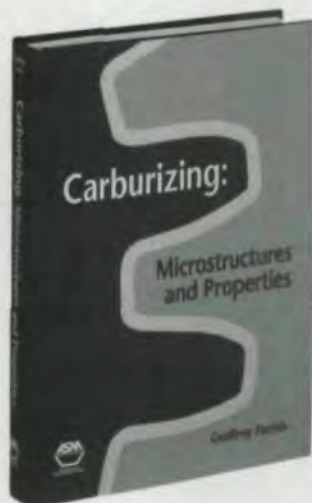


# Geoffrey Parrish, *Carburizing: Microstructures and Properties*, 2<sup>nd</sup> ed., ASM, 1999, 247 pages.

Reviewed by Robert Errichello

**G**eoffrey Parrish has updated and expanded his previous book: *The Influence of Microstructure on the Properties of Case-Carburized Components*. It now contains at least twice the material. References and bibliography include 449 citations.

Carburizing should produce a tempered martensite surface. However, other microstructures may form. These can include internal oxidation, decarburization, free carbides, retained austenite, and microcracks. Parrish discusses these as well as microsegregation, cleanliness, grain size, and residual stress.



## Bob Errichello

is a technical editor for *Gear Technology*. He founded GEARTECH, a consulting company that specializes in gear failure analysis, in 1978. Many of their investigations have involved carburized gears.

Parrish explains how microstructural variations influence bending-fatigue strength, Hertzian-fatigue resistance, wear resistance, and scuffing resistance that are of particular interest to gear designers.

The following summarizes information provided by Parrish on the cause, effect, and remedy of adverse microstructural features.

### Internal Oxidation

**Cause.** Conventional gas carburizing oxidizes elements in steel such as manganese, chromium, titanium, silicon, and aluminum, but not iron, tungsten, molybdenum, nickel, or copper. Oxidation mainly occurs along the grain boundaries at the component's surface and penetrates to a depth of one or two grains. The elements involved diffuse to form the oxides and consequently an alloy-depleted surface layer with low hardenability.

**Effect.** Since most carburized gears are ground, internal oxidation is removed from active flanks, and does not affect surface properties such as Hertzian-fatigue resistance or scuffing resistance. Internal oxidation is of most concern for its effect on the properties of unground tooth root fillets. On their own, these oxides are not thought to be particularly detrimental. However, any nonmartensitic microstructures (pearlite, Bainite) that forms due to local alloy depletion are detrimental because they:

- Reduced near-surface hardness.
- Lead to tensile residual stresses.
- Reduced bending-fatigue resistance up to 35%.

**Remedy.** Internal oxidation can be eliminated by using oxygen-free carburizing atmospheres or vacuum-carburizing processes. With conventional gas carburizing, the effects of internal oxidation can be

mitigated through steel design, process control, mechanical or chemical removal, and gear design. The steel alloy should contain:

- Carbon for adequate core strength, but not enough to reduce compressive residual stress or cause excessive distortion or growth.
- Nickel to add toughness to case and core, and suppress HTTP.
- Molybdenum to increase hardenability of case and core, and suppress HTTP.
- Manganese and chromium to enhance hardenability, but less than 0.5% of each.

Process control measures include:

- Prior to carburizing, ensure surfaces are free of scale, rust, or lubricants.
- Use vigorous quenches to minimize HTTP.
- Introduce ammonia into carburizing chamber for a short period at end of carburizing cycle.
- Use nitrogen-based or exothermic-based atmospheres.

Oxides and HTTP can be removed by electropolishing, electrochemical machining, honing, grinding, grit blasting, shot blasting and shot peening. Some of these methods risk negative side effects. For example, abusive grinding can induce tensile residual stresses and reduce bending-fatigue strength significantly.

Finally, engineers can reduce the significance of internal oxidation by designing gears with low bending stresses.

### Decarburization

**Cause.** Decarburization, carbon loss from the workpiece surface, occurs above 700°C when the furnace atmosphere contains decarburizing agents such as carbon dioxide, water vapor, hydrogen, and oxygen.



**Effect.** Shallow decarburization, a minor reduction of surface carbon, does not greatly influence macrohardness. Severe decarburization results in ferritic or bainitic surface microstructures that significantly reduce hardness and fatigue strength.

**Remedy.** Severe decarburization rarely occurs with modern atmosphere monitoring systems, good plant maintenance and supervision, and sound process control. Decarburization that is caused by inadequate diffusion time or incorrect atmosphere during the boost/diffuse cycle is easy to correct. Parts with shallow decarburization may be salvaged by grit blasting to remove the affected layer and shot peening to ensure compressive residual stresses. For deeper decarburization, consider restoration carburizing if added distortion can be tolerated.

**Carbides**

**Cause.** The amount of carbide and its morphology depend on carbon content, alloy content, and cooling rate. Carbides form at the carburizing temperature if the carbon content of the austenite exceeds the Acm carbon level. If austenite contains carbon in excess of the eutectoid composition, but less than the Acm carbon level, carbide will precipitate at the austenite grain boundaries (networks) during slow cooling from carburizing. Formation of network carbides indicates that the carbon potential was too high for the steel concerned. The elements promoting carbide formation are phosphorus, which segregates to grain boundaries, and chromium that forms spheroidal carbides. The elements that suppress carbide formation are silicon, nickel, and molybdenum. Since carbides develop during slow cooling from carburizing and reheat quenching, direct or single quenching tends to suppress carbide development.

**Effect.** Fine, dispersed carbide particles are not regarded as detrimental. However, massive globular and network carbides reduce bending-fatigue resistance. Above 30% carbide content, fracture toughness progressively declines.

**Remedy.** Methods to prevent carbides include:

- Avoid excessively high carbon potentials.
- Round edges of workpiece to deter carbon buildup.
- Use fine grain steel to reduce the amount of carbon deposited at grain boundaries.
- Avoid steel alloys prone to developing network carbides such as lean-alloy grades with high chromium or

manganese content.

- Consider subcritical annealing and requeenching to modify (spheroidize) carbides. A high reheat temperature is feasible, but might create other problems such as grain growth, retained austenite, and distortion.

**Retained Austenite**

**Cause.** If part of the martensite transformation range lies below the quenchant

**NEW! NOW YOU HAVE ANOTHER CHOICE ...**  
and it's made in AMERICA!



A/W Systems Co. announces that it is now a manufacturing source of spiral gear roughing and finishing cutters and bodies.

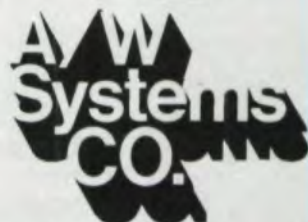
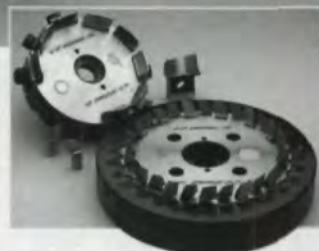
We also can manufacture new spiral cutter bodies in diameters of 5" through 12" at present.

A/W can also supply roughing and finishing cutters for most 5"-12" diameter bodies.

Whether it's service or manufacturing, consider us as an alternative source for cutters and bodies.

You'll be in for a pleasant surprise.

**NEW! Straight Bevel Cutters.**



Royal Oak, Michigan 48067  
Tel: (248) 544-3852 • Fax: (248) 544-3922



temperature, some austenite will be retained. The amount depends on the steel alloy, carbon content, quenching temperature, and quenchant temperature.

**Effect.** Retained austenite reduces hardness, strength, and compressive residual stress. It is detrimental to both bending fatigue strength and scuffing resistance. If excessive, retained austenite may promote grinding cracks.

**Remedy.** Carbon potential and quenching temperature must be appropriate for the steel alloy. Lean alloys are usually direct quenched, and highly alloyed steels are usually reheated and quenched. Quenchant temperature must be low enough to avoid excessive retained austenite. Refrigeration reduces retained austenite and raises surface hardness, but it can reduce bending fatigue strength.

### Grain Size

**Cause.** Grain size is refined by adding elements such as aluminum and vanadium to molten steel. Grain size is influenced by the austenitizing temperature and soak time, where high temperature and long soak times prior to quenching can encourage grain growth.

**Effect.** Fine grains developed after heat treatment improve most properties including fatigue strength and fracture toughness. Coarse-grained steels distort more during heat treatment and are prone to cracking and microcracking during quenching or grinding. An inherently fine grained steel can make quench hardening difficult.

**Remedy.** Purchase steel with appropriate quality and test grain size to ensure it is within ASTM No. 5 to 8. Normalize forgings and bar stock.

### Microcracking

**Cause.** Microcracks form when growing martensite plates collide severely. The risk increases when the carbon content is above 0.8%. Steels with carbide forming elements are susceptible to microcracking, especially if grains are coarse.

**Effect.** Experiments are not conclusive, but it is possible that severe microcracking will have an adverse effect on bending fatigue strength.

**Remedy.** Use fine-grained steels and avoid lean-alloy steels. Limit surface carbon content. Direct quenching appears to produce more microcracks than does reheat quenching. Tempering immediately after quenching drives off hydrogen and thereby removes a potential contributor to microcracking tendency. Do not refrigerate.

### Microsegregation

**Cause.** Microsegregation occurs as steel solidifies in ingot molds. Alloying elements segregate as dendrites grow. The order of susceptibility (most prone to least) is sulfur, niobium, phosphorus, tin, arsenic, molybdenum, chromium, silicon, manganese, and nickel. Forging distributes microsegregation into bands.

**Effect.** Hardenability of alloy-rich bands is higher than alloy-lean bands. Bainite or other HTTP may form in alloy-lean bands resulting in low fatigue strength and failure if HTTP occurs in highly stressed areas.

Order It  
YOUR WAY



## Sandwiched between tight specifications and an even tighter deadline?

Let Milwaukee Gear's custom gear services prepare your project your way.

- Engineering and design services
- Prompt, accurate quotes
- Competitive pricing
- Cost-effective manufacturing
- Complete heat treating capabilities
- On-time delivery

Supersized orders or small, we have the expertise and equipment you need for AGMA Q8 through Q14 precision gears and gear drives. All topped with the best service support in the industry.



P.O. Box 170615  
5150 N. Port Washington Rd.  
Milwaukee, WI 53217-8091  
Tel: 414-962-3532 • Fax: 414-962-2774  
E-mail: support@milwgear.com  
[www.milwaukeegear.com](http://www.milwaukeegear.com)



**Remedy.** Microsegregation cannot be avoided. However, adequate mechanical working during forging helps to redistribute segregation to more favorable directions. Soaking at elevated temperature can reduce microsegregation, but soak times can be lengthy.

**Nonmetallic Inclusions**

**Cause.** All steels contain numerous nonmetallic inclusions, but cleaner grades have fewer large inclusions. In clean steel, most inclusions are less than 0.2 µm, whereas dirty steel contains many inclusions larger than 20 µm. Some inclusions are introduced in molten steel when refractory material separates from furnace linings, runners, and ladles. Other inclusions form because of reactions during deoxidation in the melt or during solidification.

**Effect.** Many fatigue cracks initiate at nonmetallic inclusions. Harmful effects depend on chemistry, size, location, and quantity of inclusions; strength of the steel; and residual stresses immediately adjacent to inclusions. Many fatigue failures are initiated at inclusions located near the case/core boundary, where residual stresses are tensile. Hard, undeformable inclusions such as calcium aluminates, alumina, spinels, titanium nitride, and silicates are most damaging and manganese sulfide is regarded as being the least potent.

**Remedy.** Control steel cleanliness by using modern steelmaking processes such as vacuum degassing, electroslag remelting, or vacuum-arc remelting.

As you can see from the above, Parrish discusses many important microstructural features of carburized components. However, the book covers much more including core properties and case depth, postcarburizing thermal treatments (tempering and refrigeration) and postcarburizing mechanical treatments (grinding, roller burrishing, and shot peening).

Failure analyses show carburized gears often fail because of defective metallurgy. This is not surprising, given the number of variables involved, and the tight controls required for manufacturing high quality gears. More often than not, Parrish's previous book explained why these failures occurred. Now, *Carburizing*

promises to be even more helpful.

Parrish's text is a valuable resource for gear engineers, heat treaters, quality assurance personnel, and failure analysts. My confidence in a gear manufacturer will be heightened if the heat treater has a dog-eared copy of *Carburizing*. ⚙

To order *Carburizing: Microstructures and Properties*, call ASM at (440) 338-5151.

**Tell Us What You Think . . .**

If you found this article of interest and/or useful, please circle 266.

If you did not care for this article, circle 267.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).

# PROCESS Inspection

*... from the Source*

Since 1936 ITW has provided the gear industry with gear inspection devices. Put your trust in the people who invented the process.

**PRODUCTS AVAILABLE:**

- Manual double flank testers for coarse pitch.
- Manual double flank testers for fine pitch.
- Computerized double flank testers for coarse pitch.
- Computerized double flank testers for fine pitch.
- Dimension over pins or balls.
- Automatic in-line gauges.



Computerized roll tester for composite and lead

Model 2275-DOP Dimension over Pins or Balls



No matter what the application; coarse pitch, fine pitch, externals, internals, shafts, metal or plastic – we look forward to working with you.



Model 2275 Composite Gear Roller



Model 2206 Fine Pitch Gear Roller

**ITW Heartland**

1205 36th Avenue West  
 Alexandria, MN 56308 U.S.A.  
 Ph: (320) 762-8782  
 Fax: (320) 762-5260  
 E-mail: [itwgears@rea-arp.com](mailto:itwgears@rea-arp.com)



Welcome to the 2000 *Gear Technology* Gear Manufacturing Directory. Here you'll find the names and manufacturing capabilities of hundreds of top custom gear manufacturers, gear manufacturing job shops and gear sellers. Complete contact information can be found in the Company Index (p. 57). *Gear Technology* advertisers are shown in boldface type. To find the pages on which their ads appear, please see the Advertiser Index on p. 17.

Many of the companies shown here can also be found on *The Power Transmission Home Page™*, which has a far more comprehensive directory of gear categories and specifications, as well as listings for many other power transmission components.

While we have made every effort to ensure that company names and addresses are correct, we cannot be held responsible for errors of fact or omission.

If your company is not listed and you would like to be included in next year's directory, e-mail [people@geartechnology.com](mailto:people@geartechnology.com) or call (847) 437-6604.

## FIND WHAT YOU'RE LOOKING FOR

FORGED GEARS.....	P. 44
GROUND GEARS.....	P. 44
HELICAL GEARS.....	P. 45
INTERNAL GEARS.....	P. 46
PLASTIC MOLDED GEARS.....	P. 48
POWDERED METAL GEARS.....	P. 48
RACKS.....	P. 48
SPIRAL BEVEL GEARS.....	P. 54
SPLINED SHAFTS.....	P. 49
SPROCKETS.....	P. 50
SPUR GEARS.....	P. 52
STRAIGHT BEVEL GEARS.....	P. 54
WORMS.....	P. 55
WORMWHEELS.....	P. 55
COMPANY INDEX.....	P. 57

### FORGED & CAST TOOTH GEARS

Company	Min. Dia.	Max. Dia.	Quality
Agro Engineers	100 mm	2000 mm	Call
Akron Gear & Engineering	.5"	120"	Call
American Metric Corporation	Call	Call	Call
Elmwood Texas Forge	15.5"	70"	ISO 9001, AS 9000
East Point Foundry	Call	Call	Call
Browning/Emerson Power Transmission	Call	Call	Call
Euroten Corporation	Call	Call	Call
F.O. Eng.	1"	60"	AGMA 10
Fairfield Manufacturing Co., Inc.	Call	Call	Call
Falk Corporation	5000 mm	7000 mm	AGMA 7-10
Osaka Chain & Machinery, Ltd.	3"	17"	AGMA 7-10
Presrite Corporation	Call	Call	Call
Rush Gears, Inc.	Call	Call	Call
Shin Han Precision & Industry	20 mm	500 mm	Call
Stahl Gear & Machine Co.	0.5"	200"	AGMA 8
Transmission Engineering Co. Inc.	Call	Call	Call
Xtek, Inc.	6"	216"	AGMA 6-12
Xtek Mining Services	6"	220"	AGMA 8

### GROUND GEARS

Company	Min. Dia.	Max. Dia.	Quality	DP/Module
A & A Gear, Inc.	1.6"	26"	AGMA 12	1.2 DP
Acme Gear Company	Call	32.67"	AGMA 13-14	Call
ACR Industries, Inc.	.25"	21"	AGMA 15	4 DP
Advance Gear & Machine Corp.	.5"	30"	AGMA 14	Call
Akron Gear & Engineering	Call	24"	AGMA 12	3 DP
Allied Gear Co.	3"	24"	AGMA 12	2 DP
American Gear & Engineering	1/8"	24"	AGMA 12	3 DP
Ancon Gear & Instrument	1"	6"	AGMA 12	10 DP
Arrow Gear Company	1"	28"	Any	Call
Asano America, Inc.	60 mm	700 mm	JIS 0	6 module
Atlas Gear Company	1.00"	27.00"	AGMA 12	48-3 DP
B & R Machine & Gear Corp.	1"	27"	AGMA 12	4 DP
Browning/Emerson Power Transmission	1"	60"	AGMA 10	2 DP
Cardinal Engineering Company	1"	3"	AGMA 12	16-48 DP
C-B Gear & Machine	3"	71"	AGMA 15	.750 DP
Chardam Gear Co.	.5"	12"	AGMA 12	6 DP
The Cincinnati Gear Company	2"	158"	AGMA 15	.75 DP
Circle Gear & Machine	1"	36"	AGMA 12	2 DP
Clarke Gear Co.	.40"	15.75"	AGMA 15	51-2.5 DP
Commercial Gear & Sprocket	1"	16"	AGMA 14	3 DP
Cone Drive Operations Inc.	Call	Call	Call	Call
Dayton Gear	1"	16"	AGMA 12	4 DP
Delco Gear & Machine	.5"	10"	Call	Call
EMCO Gears, Inc.	1"	14"	AGMA 14	4 DP
F.O. Eng.	Call	Call	Call	Call
Fairfield Manufacturing Co., Inc.	1"	55"	AGMA 14	20-1 DP
Federal Gear Corporation	1"	12"	AGMA 12	16-4 DP
Fleuder Corporation	1"	110"	AGMA 12-14	Call
Forest City Gear Co.	.5"	13"	AGMA 14	46-3.5 DP
Fuji Univalence Corporation	Call	Call	Call	Call
Formosa Heavy Industries Corp.	50 mm	2500 mm	DIN 4	30 module
G&N Rubicon Gear Inc.	.125"	48"	AGMA 15	3/8 DP
The Gear Works—Seattle, Inc.	1"	95"	AGMA 14	1 DP
GearTec, Inc.	3"	36"	AGMA 10	1.5 DP
Gerhardt Gear Co., Inc.	3/16"	36"	Call	Call
Getrag Gears of North America	50 mm	250 mm	DIN 6	5 module
Griffin Gear	3"	72"	AGMA 12	.75 DP
Hanover Gear Mfg. Co.	25 mm	400 mm	AGMA 14	Call
HMC Gear Mfg. and Engineering	10"	200"	AGMA 14	.750 DP
Horsburgh & Scott	10"	100"	AGMA 12	Call
Indiana Power Transmission Systems, Inc.	.75"	14"	AGMA 12	Call
Indiana Tool-Indiana Gear	1"	50"	AGMA 14	1.8 DP
Inso Corporation	Call	Call	Call	Call
Invisible Gear Co.	.25"	12"	AGMA 11-15	5-64 DP
Invisite Tooling Corporation	20 mm	800 mm	DIN 6	14 module
Lawler Gear	1"	27"	AGMA 12	3 DP
Lee Tool Co.	.5"	27"	AGMA 10-11	3-32 DP
Link Gear & Machine Company	3"	49"	AGMA 12	Call
Lyon Gear & Machine	1.0"	12.0"	Call	Call
Marine Gears International Inc.	Call	48"	AGMA 12	1.5 DP
Martin Gear & Sprocket	Call	Call	Call	Call
Midwest Gear Corporation	Call	72"	AGMA 12	1 DP
Midwest Gear & Tool, Inc.	.25"	18"	Call	48-2 DP
Milwaukee Gear Company	.5"	60"	AGMA 14	48-75 DP
Modern Gear & Machine, Inc.	1"	27"	AGMA 12	3 DP
Modified Gear & Spline Inc.	.375"	14"	AGMA 10+	3 DP
Niagara Gear Corporation	.25"	13"	AGMA 15	4-50 DP
Nixon Gear Inc.	.5"	27"	AGMA 15	Call
Northern Tool and Gear Co. Ltd.	30 mm	1200 mm	DIN 3	16 module
O'Brien Gear Company	1"	50"	AGMA 10	1 DP
Oliver Gear, Inc.	1"	27.5"	AGMA 13	3.5 DP
Osaka Chain & Machinery, Ltd.	60 mm	4750 mm	AGMA 12	35 module
Overten Gear & Tool Corporation	2"	30"	AGMA 13	1.5-30 DP
Pennsylvania Gear Corporation	1"	60"	AGMA 14	1 DP
Perry Technology Corporation	Call	30"	AGMA 12	2 DP
Prager, Inc.	3"	60"	AGMA 14	24-1 DP
Precision Gear Co.	.5/8"	30"	AGMA 13	2-32 DP
Precision Gear Inc.	1"	15"	AGMA 10-15	1-48 DP
Process Gear	Call	12"	AGMA 14	Call
Productgear	1"	60"	AGMA 11	Call
Pro-Gear Co., Inc.	.500"	27.5"	AGMA 13	48-3.5 DP
Quality Transmission Components	10 mm	400 mm	JIS 0	Call
Reliance Gear Corp.	.5"	33"	AGMA 13	2 DP
RjLink International	Call	24"	AGMA 12	Call
Rush Gears, Inc.	.5"	50"	AGMA 9	Call
Schwartz Precision Gear Co.	.5"	27"	AGMA 13	64-2 DP
Selector Spline Products Inc.	.125"	15.00"	AGMA 14	48/96-3 DP
SEW-Components Pte. Ltd.	50 mm	1000 mm	ISO 6	16 module
Shamhi Gears	10 mm	1500 mm	DIN 6/5	30 module
Shin Han Precision & Industry	20 mm	500 mm	Call	1-16 module
Springer Company	6"	64"	AGMA 16	Call
Stahl Gear & Machine Co.	1"	20"	AGMA 12	1.25 DP
Stock Drive Products/Sterling Instrument	11 mm	246 mm	ISO 5	Call
Suds International Gear Works	6 mm	2400 mm	DIN 2	24 module
Supreme Gear Company	Call	Call	Call	Call
Tifco Gage & Gear	.06"	14"	AGMA 15	1-134 DP
Transmission Engineering Co. Inc.	Call	Call	Call	Call
Unicor, Inc.	.375"	7"	AGMA 12	4 DP
Unique Power Products, Inc.	.500"	18.000"	AGMA 13	4 DP
Wes Industries, Inc.	.5"	18"	AGMA 12	3 DP
Windsor Gear & Drive Inc.	.25"	12"	AGMA 11-15	5-64 DP
Xtek, Inc.	6"	120" +	AGMA 8-12	5 DP

\*Note: Coarsest DP/Module is shown throughout the index.



# GEAR MANUFACTURING DIRECTORY

## HELICAL GEARS

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
A & A Gear, Inc.	.25"	.24"	AGMA 10	3 DP	Call
ABA-PGT Inc.	.100"	4.00"	AGMA 8	12-96 DP	1.50"
Accurate Machine & Maintenance, Inc.	2"	19"	Call	Call	16"
Acme Gear Co., Inc.	Call	42"	AGMA 10	Call	Call
ACR Industries, Inc.	.25"	21"	AGMA 14	4 DP	Call
The Adams Company	1.0"	24.0"	AGMA 10	3 DP	Call
Adobe Precision Gear, Inc.	1"	40"	AGMA 10	1.5 DP	20"
Advance Gear & Machine Corp.	.5"	27"	AGMA 14	Call	Call
Advanced Jiffy Machine Products Inc.	.5"	16"	Any	4 DP	6"
Aerospace Gear Inc.	1"	16"	AGMA 10	Call	3"
Agro Engineers	3"	50"	AGMA 8	1.5 DP	31"
Akron Gear & Engineering	.5"	84"	AGMA 8	1.25 DP	60"+
Allied Gear Co.	2"	80"	Call	1.25 DP	24"
Amers Gear Co., Inc.	1"	36"	AGMA 8	3 DP	6"
American Gear & Engineering	1/8"	100"	AGMA 8	1 DP	36"
American Gear, Inc.	.125"	12"	Call	5 DP	Call
American Precision Gear Co.	Call	Call	Call	Call	Call
Ancon Gear & Instrument	.250"	6"	AGMA 12	8 DP	4"
Art International	1.000"	27.000"	AGMA 7-11	25-4 DP	12.000"
Arrow Gear Company	1"	20"	Any	Call	Call
Asano America, Inc.	20 mm	300 mm	JIS 5	12 module	280 mm
Astron Gear	.5"	72"	AGMA 9	1.25 DP	30"
Atch-Mont Gear Co., Inc.	1"	60"	AGMA 9	1.25 DP	18"
Atlas Gear Company	.500"	36.000"	AGMA 12	2.5 DP	16.00"
Avon Gear Co.	1.0"	13.0"	AGMA 10	4.0 DP	6.0"
AxiD Gear	.250"	15.000"	AGMA 10	6 DP	8.000"
B & B Gear & Machine Co., Inc.	1.125"	20"	AGMA 10	6 DP	9"
B & R Machine & Gear Corp.	1"	72"	AGMA 8-9	Call	Call
Borg, W.M., Inc.	.375"	18"	AGMA 14	16-64 DP	Call
Bonfiglioli Riduttori S.p.A.	Call	Call	Call	Call	Call
Boston Gear	.333"	6.00"	AGMA 8	6 DP	1.25"
Branko Malisa Inc.	5/16"	8"	AGMA 14	12 DP	2"
Brewer Machine & Gear Co.	Call	Call	Call	Call	Call
Browning/Emerson Power Transmission	1"	60"	AGMA 10	2 DP	Call
Buckeye Gear Co.	.06"	6"	AGMA 9	12 DP	6"
Buffalo Gear, Inc.	.5"	40"	AGMA 10	3 DP	10"
Calicut Engineering Works Ltd.	Call	2500 mm	Call	25 module	600 mm
Capstan Atlantic	.450"	6.0"	AGMA 9	64-6 DP	2.5"
Cardinal Engineering Company	.5"	3"	AGMA 10	16-72 DP	1"
Carnes-Miller Gear Co. Inc.	Call	Call	AGMA 10	3 DP	8"
Caron-Vector	Call	Call	Call	Call	Call
C-B Gear & Machine	1"	240"	AGMA 10	625 DP	50"
Chardam Gear Co.	.5"	12"	AGMA 12	6 DP	Call
Chemis Gear/Channel Power Transmission	Call	Call	Call	Call	Call
Chicago Gear Works	Call	16"	AGMA 10	4 DP	Call
The Cincinnati Gear Company	1"	300"	AGMA 15	75 DP	72"
Clarke Gear & Machine	.25"	120"	AGMA 10	1.5 DP	30"
Clarke Gear Co.	.40"	15.75"	AGMA 15	2.5 DP	8"
Classic Gears & Sprockets	1"	14"	AGMA 9	2 DP	10"
Chryson Gear/Rack Metals Div.	Call	Call	Call	Call	Call
Commercial Gear & Sprocket Co. Inc.	.25"	60"	AGMA 10	2 DP	Call
Costa Transmission Co.	Call	Call	Call	Call	Call
Crown Gear B.V.	Call	1100 mm	DIN 6	Call	Call
Davall Gear Company Ltd.	3 mm	450 mm	Call	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call
Dayton Gear	.500"	96"	AGMA 9	1 DP	24"
Delco Gear & Machine	Call	Call	Call	Call	Call
Delphos Machine & Tool, Inc.	Call	Call	Call	Call	Call
Delroyd Worm Gear Products/Nuttall Gear	1"	100"	AGMA 12	20-1 DP	30"
Doppler Gear Co.	.25"	36"	Call	2 DP	15"
EMCO Gears, Inc.	.125"	20"	AGMA 12	4 DP	36"
Engranes Industriales Rivera, S.A. de C.V.	.450"	85"	Call	1-20 DP	20"
Erbacher Gear & Machine Works	2.5"	12"	AGMA 10	4-12 DP	9"
Eucld Universal Corp.	7/16"	13"	AGMA 8	4 DP	8"
F.O. Eng	Call	Call	Call	Call	Call
Fairfield Manufacturing	.5"	120"	Call	30-1 DP	25-48"
Falk Corporation	20 mm	552"	Call	5 DP	15"
Farel Engineering (Pvt.) Ltd.	30 mm	350 mm	Call	5 module	250 mm
Federal Gear Corporation	1.00"	103"	AGMA 8	64-75 DP	135"
First Gear, Inc.	.437"	7.9"	AGMA 12	4-23 DP	8.0"
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	Call	Call
Flender Corporation	1"	110"	AGMA 12	Call	Call
Forest City Gear Co.	1/16"	17"	AGMA 12-14	250-3.5 DP	30"
Fornosa Heavy Industries Corp.	50 mm	7500 mm	DIN 4	30 module	Call
Fuji Urivance Corporation	Call	Call	Call	Call	Call
G&N Rubicon Gear Inc.	.125"	48"	AGMA 15	3/8 DP	10"
Gateway Precision Gear, Inc.	1/8"	6"	AGMA 14	16 DP	10"
Gear & Broach Inc.	1.00"	48.00"	AGMA 10	3 DP	Call
Gear Products Company	1.00"	12.00"	AGMA 9	3 DP	3.5"
Gear Research Inc.	.125"	12"	AGMA 8-12	3 DP	4"
Gear Tech Inc.	Call	132"	AGMA 8	1 DP	48"
Gear Works, Inc.	.10"	16"	AGMA 10	4 DP	10"
The Gear Works Inc.	1.0"	10.0"	AGMA 6	48-3 DP	2"
The Gear Works--Seattle, Inc.	1"	200"	AGMA 10	1.0 DP	36"
Gearmakers	1/8"	96"	AGMA 8	75 DP	36"
Gears & Gear Drives	10 mm	350 mm	DIN 8	5-5.0 module	200 mm
Gearmths Co.	.5"	48"	AGMA 5	2 DP	16"
GearTec, Inc.	.2"	48"	AGMA 10	1.5 DP	Call
General Gear Corp.	.5"	16"	AGMA 8	8 DP	6"
Gerhardt Gear Co., Inc.	3/16"	24"	Call	Call	Call
Getrag Gears of North America, Inc.	30 mm	250 mm	DIN 8	5 module	60 mm
Greenispon Engineering Works Ltd.	Call	Call	Call	Call	Call
Griffin Gear	.5"	240"	AGMA 10	5 DP	36"
Hanover Gear Mfg. Co.	Call	Call	AGMA 10	Call	9"
Hansen Machine Corp.	Call	Call	Call	Call	Call
Helsel, Inc.	1"	4"	Call	Call	Call
HMC Gear Mfg. and Engineering	10"	240"	AGMA 12	.375 DP	35"
Holland Gear Works LLC	1"	12"	Call	6 DP	Call
Holtz Gears & Sprockets	1"	15"	Call	Call	12"
Horsburgh & Scott	10"	100"	AGMA 12	Call	Call
Hub City, Inc.	.5"	20"	AGMA 8-10	Call	3"
Hytek Gear Co.	Call	6"	AGMA 10	12 DP	10"
Indiana Power Transmission Systems, Inc.	.75"	14"	AGMA 12	Call	Call
Indiana Tool - Indiana Gear	1"	40"	AGMA 14	1.8 DP	12"
Industrial Machine & Supply, Inc.	.750"	30"	Call	2 DP	15"
Industrial Sprockets & Gears Inc.	.500"	240"	AGMA 8	1 DP	39"
Innos Corporation	Call	Call	Call	Call	Call
Intech Corporation	Call	Call	Call	Call	Call
Invincible Gear Co	.75"	12"	AGMA 11-15	5-64 DP	Call
Involute Tooling Corporation	20 mm	800 mm	DIN 6	14 module	140 mm
Jade Precision Gear	Call	Call	Call	Call	Call
Keller Machine Co.	2"	12"	AGMA 8	5 DP	6"
Koro Industries	.100"	3"	AGMA 10	20 DP	1"
Kreiter Geartech	Call	Call	Call	Call	Call
Lawler Gear	1"	90"	AGMA 8	2 DP	18"
Lee Tool Co.	1.00"	27"	AGMA 10-11	3-32 DP	9"
Lincoln Tool Works, Inc.	.25"	32"	AGMA 10	2.5 DP	12"
Link Gear & Machine Co.	1"	16"	AGMA 10	Call	Call

## GEAR MANUFACTURING FOR THE AEROSPACE/DEFENSE/AUTOMOTIVE INDUSTRIES

- critical/complex aircraft engine and missile gears
- gearboxes and assemblies
- spur, helical, worm gears, sprockets and pulleys
- internal and external splines
- bevel and spiral bevel gears

Visit us at our website: [www.supremegear.com](http://www.supremegear.com)

**SUPREME GEAR COMPANY**  
19024 Florida, Roseville, MI 48066  
Phone: 810-775-6325 • Fax: 810-775-1227

CIRCLE 190

## gearmakers.com

WE MAKE EM FAST WE MAKE EM AFFORDABLE!

WE'LL MAKE YOU ONE OR ONE MILLION PIECES

### EMERGENCY SERVICE

INTERNALS	SPROCKETS	MITERS/ BEVELS
SPURS	TIMING PULLEYS	SPIRAL BEVELS
HELICALS	PINION WIRE	HERRINGBONES
WORMS	RATCHETS	GEAR GRINDING
WORM GEARS	GEAR RACK	CNC MILLING
SPLINES	BROACHING	CNC TURNING

Punxsutawney, PA

PH 215.703.0390 • FX 215.703.0391

CIRCLE 184

## INNOVATIVE RACK & GEAR COMPANY

- Custom manufactured gears and gear racks
- American and metric commercial to AGMA 11
- Racks milled or shaped
- Latest CNC milling technology
- Prototype to production quantities
- Complete or cut teeth only
- Breakdown service available

Phone: (630) 766-2652 Fax: (630) 766-3245  
E-MAIL: [gearack@aol.com](mailto:gearack@aol.com)

"THE RACKS YOU DESERVE!"

CIRCLE 182

## WINSMITH® Worm Gear Speed Reducers

Single Enveloping & Double Enveloping  
Worm Gear Speed Reducers  
Helical Gear and Planetary Reducers  
Custom, Build-to-order &  
Stock Configurations  
Innovative Solutions since 1901  
Ph: 716/592-9310 • Fax: 716/592-9546  
[www.winsmith.com](http://www.winsmith.com)

CIRCLE 188

## HALIFAX RACK & SCREW

**World-Class Gear Racks and Lead Screws**  
Halifax is one of the world's largest manufacturers of gear racks and leadscrews. Our capabilities provide motion control designers the precise product for virtually all applications.

**Halifax Rack & Screw Cutting Co., Ltd.**  
[www.hrs-ccl.co.uk](http://www.hrs-ccl.co.uk)  
Contact UK +44(0) 1484-714667  
Contact USA (606) 563-8772

CIRCLE 183



**AKRON GEAR & ENGINEERING**  
*Quality Gear Manufacturing Since 1911*  
 Fine Pitch or Coarse Pitch, Prototype to Production Runs  
 • Spur Gears to 120" OD  
 • Helical Gears to 84" OD  
 • Herringbone Gears to 72" OD  
 • Internals, Splines, Bevels, Sprockets, Racks, Worms and Worm Gears  
 24-Hour Breakdown Service on Standard Gearing!  
 Design Consultation, CAD Capabilities and much more!  
**AKRON GEAR & ENGINEERING**  
 501 Morgan Ave., Akron, OH 44311  
 (800) 258-6608 • Fax (330) 773-9005 • [www.akrongear.com](http://www.akrongear.com)

**CIRCLE 176**

**... PRODUCTION OR PROTOTYPE ...**  
**Gears • Pulleys • Pinions • Splines • Transmissions**  
**• CNC Machining • Slotting • Broaching**  
**• Machine Fab. • Gear Repair**  
*Mfg. of transmissions formerly made by the Ramsey—Tulsa—Bradley—Winch Companies*  
**514 Chickory Street**  
**Bad Axe, MI 49813**  
**Toll Free: (888) 469-8177**  
**Fax No.: (517) 269-7686**  
**Phone No.: (517) 269-8177**  
**E-mail: [vgear@avci.net](mailto:vgear@avci.net)**  
 Visit our web site at [www.valley-gear.com](http://www.valley-gear.com)

**CIRCLE 191**

**Erlbacher Gear & Machine Works**  
**CNC GEAR INSPECTION SERVICES AVAILABLE**  
**AGMA CLASS 10 SPUR & HELICAL GEARS**  
*(in preheat treated steel)*  
**Spur & Helical Gears • Splines • Sprockets**  
**FAX DRAWING FOR QUOTE**  
 425 Good Hope  
 Cape Girardeau, MO 63703  
 573-334-4040 • fax 573-334-2224  
[www.erlbachergear.com](http://www.erlbachergear.com) • [sales@erlbachergear.com](mailto:sales@erlbachergear.com)

**CIRCLE 196**

**ATA GEARS, LTD.**, established in 1937, specializes in the manufacture of high quality power transmission components. Our main products are:  
**SPIRAL BEVEL GEARS** – Klingenberg, maximum diameter 100 inches in ground, hard-cut or lapped finish.  
**OERLIKON** - maximum crown wheel diameter 26 inches.  
 Custom made right angle gear units up to 5000 HP.  
**ATA offers free technical service for ATA gears. Our delivery time for spiral bevels is 1-3 months.**  
**ATA GEARS, INC.**  
 19885 Detroit Road, Rocky River, Ohio 44116  
 Tele/Fax: 440-356-0289  
**ATA GEARS, LTD.**  
 P.O. Box 120, FIN-33101, Tampere, Finland  
 Tel: 356-3-2870111 • Fax: 356-3-2870249 • [www.ata-gears.fi](http://www.ata-gears.fi)

**CIRCLE 160**

**IKONA GEAR SYSTEM**  
*A revolutionary new planetary gearing concept now patented worldwide.*  
 • High single-stage reduction (9:1 to 5000:1)  
 • Zero backlash (0.857 arc/min)  
 • High efficiency (94%+ see AGMA 1-55589-659-6)  
 • High stiffness, multiple tooth contact  
 • 30% higher torque than others, but more compact and lighter  
 • Can be applied to any existing cycloidal-planetary system

For licensing enquiries and special design applications, call  
**IKONA GEAR TECHNOLOGY INC.**  
 Tel: (604) 618-3435 • Fax: (604) 618-3437 • [www.ikonagear.com](http://www.ikonagear.com)

**CIRCLE 181**

<b>HELICAL GEARS CONTINUED</b>					
Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
Linn Gear Company	1"	96"	Call	1 DP	24"
Lyon Gear & Machine	1.0"	20.0"	Call	Call	Call
Madison Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Marine Associates	.75"	16"	AGMA 11	3 DP	24"
Marine Gears International, Inc.	Call	96"	AGMA 10	1.75 DP	30"
Marples Gears, Inc.	.200"	8"	AGMA 13	12 DP	6"
Martin Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Master Metal Engineering	.083"	16"	AGMA 9	20 DP	16"
Merit Gear Corporation	Call	Call	Call	Call	Call
mG mmGears	Call	Call	Call	Call	Call
Midwest Gear & Tool	Call	72"	AGMA 12	1 DP	Call
Midwest Gear Company	.25"	18"	Call	48-2 DP	Call
Modern Gear & Machine, Inc.	.5"	60"	AGMA 14	48-75 DP	31"
Moore Gear Mfg.	.25"	30"	AGMA 9	3 DP	15"
Moore Machine & Gear, Inc.	.5"	90"	AGMA 8	1.5-24 DP	16"
Niagara Gear Corporation	.5"	36"	AGMA 8	1.0 DP	16"
Nisset Corp. of America	.25"	13"	AGMA 15	4-50 DP	Call
Nixon Gear Inc.	Call	Call	Call	Call	Call
Nordex, Inc.	.25"	120"	Call	Call	Call
North Shore Gear and Tool Corporation	.500"	5"	AGMA 10	16 DP	Call
Northern Tool and Gear Co. Ltd.	Call	5.5"	AGMA 12	24-180 DP	Call
O'Brien Gear Company	30 mm	1200 mm	DIN 3	16 module	600 mm
Oliver Gear, Inc.	1"	166"	AGMA 10	1 DP	19"
Ouka Chain & Machinery, Ltd.	72"	72"	AGMA 9	1.5 DP	26"
Overton Gear & Tool Corporation	60 mm	4750 mm	AGMA 11-12	35 module	1100 mm
Penn Machine Company	2"	39"	AGMA 13	1.5-30 DP	Call
Pennsylvania Gear Corporation	2"	72"	AGMA 8	1 DP	38"
Perry Technology Corporation	1"	72"	AGMA 13	1 DP	36"
Phillips-Moldex Company	Call	36"	AGMA 10	2 DP	8"
PLC Design	Call	6"	AGMA 6-8	20-120 DP	Call
Poly Hi Solidar	.125"	16"	AGMA 12	8 DP	16"
Prager, Inc.	Call	Call	Call	Call	Call
Precipart Corporation	1"	80"	AGMA 11	48-1 DP	40"
Precision Gear Co.	.060"	6"	AGMA 10	28-220 DP	2"
Precision Gear Inc.	1/8"	26"	AGMA 13	2.5-96 DP	13"
Precision Gears, Inc.	1"	15"	AGMA 10-15	1-48 DP	12"
Presrite Corporation	.25"	26.00"	AGMA 10	2 DP	36"
Process Gear	3"	14"	AGMA 7-10	2-8 DP	8"
Productgear	Call	Call	Call	Call	Call
Pro-Gear Co., Inc.	1.0"	60.0"	AGMA 11	Call	Call
Prophet Gear	500"	27.5"	AGMA 13	48-3.5 DP	11"
The Purdy Corporation	1/8"	12"	AGMA 10	5 DP	8"
Quality Gear	Call	Call	Call	Call	Call
Quality Gear Mfg.	.5"	59"	Call	2 DP	15-17"
Quality Transmission Components	.125"	26"	AGMA 5-10	4-6 DP	16"
Radina - M	10 mm	1000 mm	JIS 1	Call	Call
Rapid Gear	20 mm	650 mm	Call	10 module	150 mm
Rawling Gear Inc.	Call	Call	Call	Call	Call
Reef Gear Mfg.	.750"	10"	Call	Call	Call
Reliance Gear Corporation	.250"	26"	AGMA 11	Call	4"
RJLink International, Inc.	Call	24"	AGMA 12	2 DP	30"
Roe Machine	Call	38"	Call	Call	Call
Romson Gears Pty. Ltd.	Call	Call	Call	4 DP	6"
Rush Gears, Inc.	.25"	48"	AGMA 8	2-64 DP	6"
Schafer Gear Works, Inc.	.250"	16"	AGMA 10	3 DP	10"
Schwartz Precision Gear Co.	.75"	12"	AGMA 13	64-5 DP	4"
Seitz Corporation	Call	Call	Call	Call	Call
SEW-Components Pre Ltd	50 mm	1000 mm	ISO 6	16 module	300 mm
Shanbi Gears	10 mm	3200 mm	DIN 6	30 module	Call
Shin Han Precision & Industry	20 mm	500 mm	Call	1-16 module	Call
SPM	12.0 mm	60.0 mm	AGMA 11	Call	14 mm
Springer Company	Call	Call	Call	Call	Call
Stahl Gear & Machine Co.	1"	200"	AGMA 12	1 DP	24"
STD Precision Gear & Instrument, Inc.	Call	Call	Call	Call	Call
Stock Drive Products/Sterling Instrument	20 mm	116 mm	Call	1-3 module	Call
Suda International Gear Works	6 mm	3400 mm	DIN 2	24 module	Call
Sumitomo Machinery Corp. of America	Call	Call	Call	Call	Call
Supreme Gear Company	Call	Call	Call	Call	Call
Synco Custom Injection Molders	Call	Call	Call	Call	Call
Ta-Tung Gear Co.	Call	Call	Call	Call	Call
Tifco Gauge & Gear	.06"	12"	AGMA 15	4.5 DP	4"
Titanium Engineering & Mfg.	1.0"	9.00"	AGMA 11	3 DP	Call
Transmission Engineering Co. Inc.	Call	Call	Call	Call	Call
Tsubakimoto Chain Co.	180 mm	630 mm	Call	Call	Call
Unicor, Inc.	.375"	12.000"	AGMA 12	4 DP	6"
Union Gear & Sprocket Corp.	.500"	.56"	AGMA 8	2 DP	6"
Unique Power Products, Inc.	.500"	15.000"	AGMA 13	4 DP	5.000"
Von Ruden Mfg. Inc.	.5"	12.0"	AGMA 9	4.25 DP	8"
Vorpe Microgears Switzerland	Call	1"	AGMA 12	30 DP	Call
Weatherford ALS	2"	60"	AGMA 7	1.5 DP	20"
West Industries, Inc.	.5"	18"	AGMA 12	3 DP	16.0"
Windsor Gear & Drive Inc.	0.75"	12"	AGMA 11-15	5-64 DP	Call
Wohlet Corp	7"	60"	Call	6-14 DP	4"
Xtek, Inc.	6"	60"	AGMA 6-12	625 DP	30"
Xtek Mining Services	6"	220"	AGMA 8	3/8 DP	24"

<b>INTERNAL GEARS</b>					
Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
A & A Gear, Inc.	.75"	18"	AGMA 10	3 DP	Call
ABA-PGT, Inc.	.100"	4.00"	AGMA 8	12-96 DP	3.00"
Accurate Machine & Maintenance, Inc.	2"	36"	Call	Call	8"
Acme Gear Co., Inc.	Call	36"	AGMA 10	Call	Call
ACR Industries, Inc.	.25"	19"	AGMA 14	4 DP	4"
The Adams Company	.75"	18.0"	AGMA 8	4 DP	5.0"
Adobe Precision Gear, Inc.	1"	20"	AGMA 8	3 DP	10"
Advance Gear & Machine Corp.	.5"	30"	AGMA 10	Call	Call
Advanced Jiffy Machine Products Inc.	.5"	8"	Call	Call	2"
Aerospace Gear Inc.	2"	6"	AGMA 10	Call	2"
Akron Gear & Engineering	Call	36"	AGMA 8	3 DP	6"
All Power-Transmission Inc.	1.5"	30"	AGMA 8	3/8 DP	11"
Allied Gear Co.	2"	36"	Call	3 DP	6"
Amers Gear Co. Inc.	2"	36"	AGMA 8	3 DP	6"
American Gear & Engineering	1"	38"	AGMA 8	2.5 DP	6"
American Gear, Inc.	.125"	35"	Call	Call	Call
Ancon Gear & Instrument Corp.	.375"	5"	AGMA 10	24 DP	17"
Arrow Gear Company	1.5"	17"	AGMA 13	3.6 DP	8"
Asano America, Inc.	50 mm	1000 mm	JIS 2	12 module	160 mm
Astron Gear	.5"	36"	AGMA 9	4 DP	8"
Atch-Mont Gear Co., Inc.	1"	36"	AGMA 8	2 DP	6"
Atlas Gear Company	.500"	36.000"	AGMA 10	3 DP	6.00"
Avon Gear Co.	3.0"	36.0"	AGMA 8	3.5 DP	6.0"
AxiGear	.500"	6.000"	AGMA 10	8 DP	1.000"
B & B Gear & Machine Co., Inc.	Call	18"	AGMA 8	6 DP	5"
B & R Machine & Gear Corp.	Call	36"	AGMA 9	Call	Call
Berg, W.M., Inc.	2"	6"	AGMA 14	32-120 DP	125"
Boston Gear	1.00"	6.00"	AGMA 8	16 DP	312"
Brad Foote Gear Works	2"	100"	Call	1.0 DP	16"



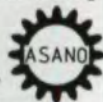
## GEAR MANUFACTURING DIRECTORY

INTERNAL GEARS CONTINUED					
Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
Branko Malisa Inc.	Call	6"	AGMA 10	Call	Call
Brewer Machine & Gear Co.	Call	Call	Call	Call	Call
Buckeye Gear Co.	.06"	4"	AGMA 7	6 DP	1"
Buffalo Gear, Inc.	.5"	18"	AGMA 9	4 DP	4"
Calicut Engineering Works Ltd.	Call	500 mm	Call	8 module	100 mm
Cardinal Engineering Company	.5"	3"	AGMA 8	16-72 DP	1"
Carnes-Miller Gear Co. Inc.	Call	Call	AGMA 10	3 DP	5"
C-B Gear & Machine	1"	120"	AGMA 10	1 DP	12"
Chardan Gear Co.	.5"	12"	AGMA 12	6 DP	Call
Chicago Gear Works	Call	Call	Call	Call	Call
The Cincinnati Gear Company	.500"	.220"	AGMA 10	1 DP	.72"
Circle Gear & Machine	Call	42"	AGMA 9	2 DP	8"
Clark Gear Co.	.50"	12.0"	AGMA 11	6 DP	8.0"
Commercial Gear & Sprocket Co. Inc.	.5"	16"	AGMA 8	4 DP	Call
Conz Drive Operations Inc.	2.495"	49.25"	Call	Call	Call
Davall Gear Company Ltd.	15 mm	260 mm	AGMA 13	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call
Dayton Gear	.5"	36"	AGMA 8	3 DP	5"
Delco Gear & Machine	Call	Call	Call	Call	Call
Doppler Gear Co.	.50"	16"	Call	6 DP	6"
Ekelo aandrijftechniek BV	60 mm	983 mm	AGMA 8	12 DP	Call
EMCO Gears, Inc.	.5"	7"	AGMA 12	8 DP	2"
Engranes Industriales Rivera, S.A. de C.V.	1.750"	20"	Call	4-6 DP	4"
F.O.Eng.	Call	Call	Call	Call	Call
Fairfield Manufacturing	3"	100"	AGMA 14	20-2 DP	5-12"
Falk Corporation	Call	Call	Call	Call	Call
Farrel Engineering (Pvt.) Ltd.	75 mm	250 mm	Call	5 module	75 mm
Federal Gear Corporation	1.00"	100"	AGMA 8	2 DP	8"
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	Call	Call
Flender Corporation	25"	63"	AGMA 12	4 DP	Call
Forest City Gear Co.	.25"	.17"	AGMA 11	200-4 DP	.5"
Formosa Heavy Industries Corp.	50 mm	2900 mm	DIN 7	12 module	220 mm
G&N Rubicon Gear Inc.	1.50"	.48"	AGMA 15	38 DP	10"
Gateway Precision Gear, Inc.	.785"	.7"	AGMA 10	24 DP	.75"
Gear & Broach Inc.	.5"	16.00"	AGMA 9	Call	Call
Gear Products Company	2.00"	20.00"	AGMA 9	3 DP	3.5"
Gear Research Inc.	.625"	10"	AGMA 8	6 DP	2"
Gear Tech Inc.	Call	41"	AGMA 8	2 DP	6"
Gear Works, Inc.	1.00"	12"	AGMA 10	4 DP	5"
The Gear Works—Seattle, Inc.	1"	240"	AGMA 10	1.0 DP	14"
Gearmakers	.3/8"	.96"	AGMA 8	.75 DP	8"
Gearsmiths Co.	.5"	32"	AGMA 5	3 DP	5"
GearTec, Inc.	2"	Call	Call	Call	Call
Gerhardt Gear Co., Inc.	1"	36"	Call	Call	Call
Getrag Gears of North America, Inc.	80 mm	250 mm	DIN 9	2.5 module	40 mm
Greenhup Engineering Works Ltd.	Call	Call	Call	Call	Call
Griffin Gear	1"	120"	AGMA 10	1 DP	7"
Hanover Gear Mfg. Co.	Call	Call	AGMA 10	Call	9"
Hansen Machine Corp.	Call	Call	Call	Call	Call
Heslet Inc.	1.5"	4"	Call	Call	Call
HMC Gear Mfg. and Engineering	60"	246"	AGMA 12	.375 DP	.35"
Holland Gear Works LLC	1"	18"	Call	Call	45"
Holtz Gears & Sprockets	1"	15"	Call	Call	5"
Hornburgh & Scott	Call	Call	Call	Call	Call
Hytex Gear Co.	Call	5"	AGMA 10+	12 DP	Call
Indiana Power Transmission Systems	3"	12"	AGMA 12	Call	Call
Indiana Tool - Indiana Gear	1"	72"	AGMA 10	1.8 DP	15"
Industrial Sprockets & Gears Inc.	1.000"	60"	AGMA 8	2 DP	8"
Intech Corporation	Call	Call	Call	Call	Call
Invisible Gear Co	6"	24"	AGMA 11-15	Call	Call
ITW Spiroid	Call	Call	Call	Call	Call
Jade Precision Gear	Call	Call	Call	Call	Call
Kreiter Geartech	Call	Call	Call	Call	Call
Lawler Gear	1"	36"	AGMA 8	3 DP	6"
Lee Tool Co.	3"	10"	AGMA 10	8-16 DP	3"
Lincoln Tool Works, Inc.	.25"	36"	AGMA 10	3 DP	6"
Link Gear & Machine Co.	1"	22"	AGMA 10	Call	Call
Linn Gear Company	1"	90"	Call	Call	Call
Lyon Gear & Machine	1.0"	20.0"	Call	Call	Call
Madson Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Marine Associates	1"	18"	Call	Call	4"
Marine Gears International, Inc.	Call	18"	AGMA 9	3 DP	5"
Marples Gears, Inc.	.375"	5"	AGMA 9	16 DP	15"
Master Metal Engineering	.375"	10"	AGMA 10	20 DP	4.5"
Merit Gear Corporation	Call	Call	Call	Call	Call
mG miniGears	Call	Call	Call	Call	Call
Midwest Gear Corporation	Call	100"	Call	1.25 DP	9"
Midwest Gear & Tool, Inc.	.25"	18"	Call	48-2 DP	Call
Midwaukee Gear Company	3"	50"	AGMA 12	10-.75 DP	8"
Modern Gear & Machine, Inc.	.50"	16"	AGMA 9	4 DP	5"
Modified Gear & Spline Inc.	1.0"	14.0"	AGMA 10+	4 DP	Call
Moore Gear Mfg.	1"	36"	AGMA 8	3 DP	4"
Moore Machine & Gear	1.0"	12"	AGMA 10	4 DP	4"
Niagara Gear Corporation	Call	Call	Call	Call	Call
Nissei Corp. of America	Call	Call	Call	Call	Call
Nixon Gear Inc.	.5"	36"	AGMA 10	Call	Call
Nordex, Inc.	.750"	6"	AGMA 10	16 DP	.500"
North Shore Gear and Tool Corporation	Call	1"	AGMA 10	48 DP	Call
Northern Tool and Gear Co. Ltd.	30 mm	1000 mm	DIN 6	9 module	180 mm
O'Brien Gear Company	1/4"	125"	AGMA 10	.75 DP	21"
Ohio Broach & Machine Co.	Call	Call	Call	Call	Call
Oliver Gear, Inc.	1"	36"	AGMA 9	3 DP	6"
Orlando Gear Company	1.00"	6"	Call	5 DP	4"
Osaka Chain & Machinery, Ltd.	100 mm	4000 mm	AGMA 10-11	35 module	1100 mm
Overton Gear & Tool Corporation	2"	42"	AGMA 13	1.5-30	DP
Penn Machine Company	2.0"	34"	AGMA 8	2.5 DP	6"
Pennsylvania Gear Corporation	1"	72"	AGMA 10	1 DP	12"
Perry Technology Corporation	Call	44"	AGMA 10	2 DP	8"
Phillips-Moldex Company	Call	6"	AGMA 6-8	20-120 DP	Call
PIC Design	Call	6"	AGMA 10	Call	Call
Prager, Inc.	1"	40"	AGMA 10	24-3 DP	40"
Precision Corporation	1"	10"	AGMA 10	28-220 DP	4"
Precision Gear Co.	Call	Call	Call	Call	Call
Precision Gear Inc.	3"	20"	AGMA 10-15	1-48 DP	12"
Precision Gears, Inc.	.50"	30.00"	AGMA 8	4 DP	6"
Productgear	1.0"	60.0"	AGMA 11	Call	Call
Prophet Gear	Call	6"	Call	10 DP	3"
The Purdy Corporation	Call	Call	Call	Call	Call
Quality Gear	Call	Call	Call	Call	Call
Quality Gear Mfg.	Call	Call	Call	Call	Call
Quality Transmission Components	20 mm	1000 mm	JIS 1	Call	Call
Radina - M	30 mm	1000 mm	Call	10 module	120 mm
Randy's Ring & Pinion	Call	Call	Call	Call	Call
Rapid Gear	Call	Call	Call	Call	Call
Rawling Gear Inc.	Call	Call	Call	Call	Call
Reef Gear Mfg.	.750"	6"	AGMA 9	Call	2"
Reliance Gear Corporation	.500"	22"	AGMA 11	2 DP	5"
RJLink International	2"	36"	AGMA 9	Call	Call
Romson Gears Pty. Ltd.	Call	Call	Call	Call	Call

## ASANO GEAR CO., LTD.

*Gear Specialists Serving Industries Worldwide*

Japan's leading manufacturer of transmission gears, hypoid gears, engine gears, vehicle axles and speed-accelerating/decelerating gear assemblies.



Sales office: Asano America, Inc.  
5555 Oakbrook Parkway, Suite 440,  
Norcross, GA 30093  
Phone: (770) 449-0500, Fax: (770) 209-0165  
Email: [Asano@AsanoAmerica.com](mailto:Asano@AsanoAmerica.com)  
Web: [www.AsanoAmerica.com](http://www.AsanoAmerica.com)

CIRCLE 195

## B&R Machine & Gear Corporation

- A custom job shop manufacturing gears to your specifications or samples.
- Spiral bevel gears to 66° PD.
- In-house heat treating and gearbox repair facility.
- Breakdown services our specialty.



PO BOX 536, 4809 US HWY 45,  
SHARON, TN 38255  
(901) 456-2636 FAX (901) 456-3073  
WATS LINE: 1-800-238-0651

CIRCLE 207

**FIND THE  
PRODUCTS YOU  
NEED TODAY!**

- ACTUATORS
- ADJUSTABLE SPEED DRIVES
- BEARINGS
- BELT DRIVES
- BRAKES
- CHAIN DRIVES
- CLUTCHES
- CONTROLS
- COUPLINGS
- GEARS
- GEAR DRIVES
- HYDRAULIC POWER
- LINEAR MOTION
- MOTORS
- SENSORS

**www.powertransmission.com**  
THE SOURCE FOR POWER TRANSMISSION COMPONENTS ONLINE



# GEAR MANUFACTURING DIRECTORY

## INTERNAL GEARS CONTINUED

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
Rush Gears, Inc.	1"	Call	AGMA 8	2-64 DP	6"
Schaefer Gear Works, Inc.	1.000"	10"	AGMA 8	6-64 DP	4"
Schwartz Precision Gear Co.	1.0"	30"	AGMA 13	64-5 DP	8"
Seitz Corporation	Call	Call	Call	Call	Call
Selector Spline Products Inc.	3.00"	10.00"	AGMA 12	Call	1.5"
Shanthi Gears	36 mm	1600 mm	AGMA 10	Call	165 mm
Shin Han Precision & Industry	30 mm	500 mm	Call	Call	Call
Springer Company	Call	Call	Call	Call	Call
Stahl Gear & Machine Co.	1"	36"	AGMA 8	1.5 DP	6"
<b>Stock Drive Products/Sterling Instrument</b>	29 mm	118 mm	ISO 7	-5-1 module	5-10 mm
Stock Gears Inc.	Call	Call	Call	Call	Call
Suda International Gear Works	30 mm	1600 mm	DIN 3	12 module	300 mm
<b>Supreme Gear Company</b>	2"	10"	AGMA 13	6-64 DP	2"
Syntec Custom Injection Molders	Call	Call	Call	Call	Call
Tifco Gauge & Gear	.06"	12"	AGMA 15	4 DP	4"
Transmission Engineering Co., Inc.	Call	Call	Call	Call	Call
Trogetec Inc.	Call	Call	Call	Call	Call
Union Gear & Sprocket Corp.	2.00"	30"	AGMA 8	3 DP	3"
Unique Power Products, Inc.	3.000"	12.000"	AGMA 13	4 DP	5.000"
Vorpe Microgears Switzerland	.5"	1.5"	AGMA 12	Call	Call
West Industries, Inc.	1.00"	18"	AGMA 9	4 DP	5.0"
Windsor Gear & Drive Inc.	6"	24"	AGMA 11-15	Call	Call
Xtek, Inc.	12"	48"	AGMA 6-8	2 DP	12"

## PLASTIC GEARS (INJECTION MOLDED)

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
ABA-PGT, Inc.	.100"	4.00"	AGMA 9	12-150 DP	2.50"
Albro Gear & Instrument	.100"	4.00"	AGMA 11	24 DP	Call
Berg, W.M., Inc.	.375"	4"	AGMA 8	16-64 DP	.375"
Boston Gear	.375"	3.00"	AGMA 8	24 DP	.250"
Davall Gear Company Ltd.	3 mm	250 mm	Call	Call	Call
Delco Gear & Machine	Call	Call	Call	Call	Call
F.O. Eng.	Call	Call	Call	Call	Call
Gear Products Company	1.00"	10.00"	AGMA 8	4 DP	2.5"
Gerhardt Gear Co., Inc.	Call	Call	Call	Call	Call
ITW Spiroid	Call	Call	Call	Call	Call
Kleiss Gears	Call	Call	Call	Call	Call
Madison Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Martin Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Nelmiech Electronics	0.4"	1.4"	Call	Call	Call
Nor Elektronik, Ltd.	Call	Call	Call	Call	Call
Performance Gear Systems, Inc.	Call	Call	Call	Call	Call
Phillips-Moldex Company	Call	6"	AGMA 6-8	20-120 DP	Call
Poly Hi Solidar	.5"	6"	AGMA 6-8+	16 DP	1"
Process Gear	Call	Call	Call	Call	Call
Productgear	Call	Call	Call	Call	Call
Putnam Precision Molding, Inc.	.4"	300"	Call	Call	Call
<b>Quality Transmission Components</b>	6 mm	150 mm	JIS 8	Call	Call
Rush Gears Inc.	.25"	Call	AGMA 8	2-64 DP	6"
Seitz Corporation	Call	Call	Call	Call	Call
SPM	12.0"	60.0"	AGMA 11	Call	14"
<b>Stock Drive Products/Sterling Instrument</b>	.25"	5.15"	AGMA 8	16 DP	.75"
Stock Gears Inc.	Call	Call	Call	Call	Call
Syntec Custom Injection Molders	.125"	4.7"	Call	Call	Call
Transmission Engineering Co. Inc.	Call	Call	Call	Call	Call
UFE Incorporated	Call	Call	AGMA 10	Call	Call
Unitor, Inc.	.375"	6.00"	AGMA 12	4 DP	6"
Winzler Gear	.100"	6.00"	Call	12-100 DP	1"

## POWDER METAL GEARS

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
Advance Gear & Machine Corp.	Call	Call	Call	Call	Call
Asco Sintering	Call	3"	Call	Call	Call
Burgess Norton Mfg. Co.	Call	Call	Call	Call	Call
Capstan Atlantic	.450"	6.0"	AGMA 9	64-6 DP	2.5"
Cloyes Gear	Call	Call	Call	Call	Call
Crown Gear B.V.	Call	Call	Call	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call
F.O. Eng.	Call	Call	Call	Call	Call
Hehel, Inc.	.5"	8"	Call	Call	Call
Indiana Power Transmission Systems	Call	Call	Call	Call	Call
ITW Spiroid	Call	Call	Call	Call	Call
Metal Ceramics	Call	Call	Call	Call	Call
mG miniGears	Call	Call	Call	Call	Call
<b>Quality Transmission Components</b>	10 mm	150 mm	JIS 6	Call	Call
Rush Gears, Inc.	.5"	50"	AGMA 9	3 DP	Call
Selector Spline Products Inc.	.500"	15.0"	AGMA 12	Call	3.0"
<b>Stock Drive Products/Sterling Instrument</b>	Call	Call	Call	Call	Call
Transmission Engineering Co., Inc.	Call	Call	Call	Call	Call
Trogetec Inc.	Call	Call	Call	Call	Call

## RACKS

Company	Max. Face	Max. Length	Quality	DP/Module
ABA-PGT, Inc.	1.00"	12"	AGMA 8	12-64 DP
ACR Industries, Inc.	3"	15"	AGMA 12	6 DP
Adobe Precision Gear, Inc.	Call	Call	AGMA 8	Call
Agro Engineers	10"	40"	AGMA 8	3 DP
<b>Akron Gear &amp; Engineering</b>	Call	40"	AGMA 8	3 DP
American Gear & Engineering	10"	96"	AGMA 8	2.5 DP
American Metric Corporation	Call	Call	Call	Call
Anderson-Cook Incorporated	15"	60"	AGMA 14+	Call
B & B Gear & Machine Co., Inc.	6"	30"	AGMA 8	6 DP
Berg, W.M., Inc.	.75"	48"	AGMA 13	16-120 DP
Boston Gear	3.500"	72"	AGMA 8	3 DP
Browning/Emerson Power Transmission	3.5"	146"	AGMA 8	3 DP
Calicut Engineering Works Ltd.	150 mm	2000 mm	Call	30 module
Capstan Atlantic	Call	Call	Call	Call
C-B Gear & Machine	20"	Any	AGMA 10	625 DP
Chicago Gear Works	Call	Call	Call	Call
<b>The Cincinnati Gear Company</b>	Call	Call	Call	Call
Circle Gear & Machine	Call	120"	AGMA 8	1.5 DP
Commercial Gear & Sprocket	4"	36"	AGMA 8	3 DP
Davall Gear Company Ltd.	Call	Call	Call	Call
Dayton Gear	4"	48"	AGMA 8	3 DP
Delco Gear & Machine	Call	Call	Call	Call
Delphos Machine & Tool	Call	Call	Call	Call
Ekkelo aandrijftechniek BV	Call	2000 mm	AGMA 8	Call
F.O. Eng.	Call	Call	Call	Call
Fairfield Manufacturing Co., Inc.	12"	60"	AGMA 9	1.5 DP
The Gear Works—Seattle, Inc.	8"	72"	AGMA 8	1.0 DP
<b>Gearmakers</b>	8"	144"	AGMA 8	.75 DP
Gerhardt Gear Co., Inc.	Call	Call	Call	Call
Griffin Gear	Call	Call	AGMA 9	.5 DP
Halifax Rack & Screw Cutting Co.	18"	Call	AGMA 11	1 DP
Hansen Machine Corp.	Call	Call	Call	Call
HMC Gear Mfg. and Engineering	40"	220"	AGMA 10	.375 DP



# GEAR MANUFACTURING DIRECTORY

## RACKS CONTINUED

Company	Max. Face	Max. Length	Quality	DP/Module
Industrial Sprockets & Gears Inc.	12"	480"	AGMA 9	1 DP
Innovative Rack & Gear Company, Inc.	10"	84"	AGMA 11	1 DP
Invisible Gear Co.	1.5"	31"	AGMA 8-10	Call
Jade Precision Gear	Call	Call	Call	Call
Lawler Gear	3"	144"	AGMA 8	4 DP
Lee Tool Co.	2"	36"	AGMA 10	50-14 DP
Lincoln Tool Works, Inc.	6"	24"	AGMA 8	4 DP
Linn Gear Co.	12"	144"	Call	1 DP
Maples Gears, Inc.	5"	5"	AGMA 11	16 DP
Master Metal Engineering	6"	48"	AGMA 8	2 DP
Moore Gear Mfg.	6.75"	150"	AGMA 9	1.5 DP
Moore Machine & Gear	20"	120"	AGMA 8	6 DP
Nordex, Inc.	500"	36"	AGMA 10	16 DP
O'Brien Gear Company	9"	100"	AGMA 10	1 DP
Ohio Branch & Machine Co.	Call	Call	Call	Call
Oliver Gear, Inc.	12"	72"	AGMA 7	1 DP
Penn Machine Company	8"	36"	AGMA 6-8	2 DP
Pennsylvania Gear Corporation	Call	Call	Call	Call
Perry Technology Corporation	10"	200"	AGMA 12	2 DP
PIC Design	2"	36"	AGMA 12	8 DP
Poly Hi Solidur	Call	Call	Call	Call
Prager, Inc.	8"	120"	AGMA 10	24-1 DP
Precipart Corp.	1"	4"	AGMA 10	28-220 DP
Rapid Gear	Call	Call	Call	Call
Ronson Gears Pty. Ltd.	Call	Call	Call	Call
Rush Gears, Inc.	6"	144"	AGMA 8	2-64 DP
Schwartz Precision Gear Co.	6"	24"	AGMA 12	64-3 DP
Selector Spine Products Inc.	3"	80.0"	AGMA 12	3 DP
Shanbi Gears	50 mm	1120 mm	DIN 8	6 DP
Stahl Gear & Machine Co.	12"	144"	AGMA 8	1.25 DP
STD Precision Gear & Instrument	Call	Call	Call	ISO 5-9
Stock Drive Products/Sterling Instrument	3-30 mm	1021 mm	ISO 5-9	4-3 module
Stock Gears Inc.	Call	12"	AGMA 5-7	24-48 DP
Suda International Gear Works	300 mm	3200 mm	DIN 3	18 module
Syntec Custom Injection Molders	Call	Call	Call	Call
Ta-Tung Gear Co.	Call	Call	Call	Call
Transmission Engineering Co. Inc.	Call	Call	Call	Call
Trogetec Inc.	Call	Call	Call	Call
Unicor, Inc.	2"	12"	AGMA 12	4 DP
Union Gear & Sprocket Corp.	3"	72"	AGMA 8	5 DP
Windsor Gear & Drive Inc.	1.5"	31"	AGMA 8-10	Call
Xtek, Inc.	14"	120"	AGMA 6-8	1 DP
Xtek Mining Services	12"	240"	Call	.75 DP

## SPLINED SHAFTS

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Length
A & A Gear, Inc.	.5"	5.5"	Call	Call	140"
Accurate Machine & Maintenance, Inc.	.5"	16"	Call	Call	16"
Acme Gear Co., Inc.	Call	Call	Call	Call	Call
ACR Industries, Inc.	.25"	12.5"	AGMA 13	Call	60"
The Adams Company	.625"	5.0"	AGMA 8	5 DP	48.0"
Adobe Precision Gear, Inc.	1"	16"	AGMA 8	5 DP	60"
Advance Gear & Machine Corp.	.5"	16"	Call	Call	Call
Advanced Jiffy Machine Products Inc.	.5"	16"	Any	Call	36"
Aerospace Gear Inc.	Call	6"	Call	Call	10"
Akron Gear & Engineering	100"	18"	AGMA 8	1.25 DP	55"
Albro Gear and Instrument Inc.	4.0"	4.0"	AGMA 11	24 DP	3"
All Power-Transmission Inc.	1.5"	16"	AGMA 8	Call	48"
Allied Gear Co.	1"	10"	Call	3 DP	120"
Amers Gear Co., Inc.	.5"	6"	AGMA 8	Call	50"
American Gear & Engineering	1/8"	16"	AGMA 8	1 DP	190"
American Gear, Inc.	Call	Call	Call	Call	Call
American Metric Corporation	Call	Call	Call	Call	Call
American Precision Gear Co.	Call	Call	Call	Call	Call
Anderson-Cook Incorporated	Call	Call	ANSI 5	16 DP	Call
Arrow Gear Company	Call	Call	Call	Call	Call
Astron Gear	.75"	40"	AGMA 9	4-8 DP	42"
Aitch-Mont Gear Co., Inc.	1"	12"	AGMA 8	3 DP	36"
Atlas Gear Company	.375"	12.00"	AGMA 10	.75 DP	56.000"
Avon Gear Co.	1.0"	12.0"	AGMA 8	6.0 DP	15.0"
AxiDgear	.250"	8.000"	AGMA 10	4-8 DP	12.000"
B & B Gear & Machine Co., Inc.	Any	20"	AGMA 8	6 DP	72"
B & R Machine & Gear Corp.	Call	Call	Call	Call	Call
Brad Foote Gear Works	2"	12"	Call	Call	36"
Branko Malisa Inc.	Call	Call	AGMA 10	Call	18"
Brewer Machine & Gear Co.	Call	Call	Call	Call	Call
Buckeye Gear Co.	.05"	6"	AGMA 9	10 DP	12"
Buffalo Gear, Inc.	.5"	40"	AGMA 9	3 DP	16.5"
Calicut Engineering Works Ltd.	Call	Call	Call	25 module	1200 mm
Cardinal Engineering Company	.5"	3"	AGMA 8	16-72 DP	6"
Carnes-Miller Gear Co. Inc.	Call	Call	AGMA 10	3 DP	8"
C-B Gear & Machine	1"	36"	AGMA 8	Call	Any
Chardam Gear Co.	.5"	12"	AGMA 12	6 DP	Call
Chicago Gear Works	Call	16"	AGMA 10	Call	18"
The Cincinnati Gear Company	.5"	60"	AGMA 12	.75 DP	276"
Circle Gear & Machine	.5"	12"	AGMA 8	Call	120"
Clarke Gear Co.	.10"	16.0"	AGMA 10	8 DP	16"
Classic Gears & Sprockets	1"	12"	AGMA 9	6 DP	30"
Commercial Gear & Sprocket Co. Inc.	.25"	60"	AGMA 10	3 DP	36"
Davall Gear Company Ltd.	5 mm	200 mm	Call	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call
Dayton Gear	500"	16"	Class 4	3 DP	56"
Delco Gear & Machine	Call	Call	Call	Call	Call
Delpbos Machine & Tool, Inc.	Call	Call	Call	Call	Call
Delroyd Worm Gear Products/Nuttall Gear	Call	Call	Call	Call	Call
Doppler Gear Co.	.25"	16"	Call	4 DP	Call
Ektelo aandrijftechiek BV	25 mm	65 mm	AGMA 8	Call	1500 mm
Erlbacher Gear & Machine Works	1"	10"	Call	4 DP	30"
Eichld Universal Corp.	.5/8"	4"	Call	8/16 DP	8"
F.O. Eng.	Call	Call	Call	Call	Call
Fairfield Manufacturing	Call	10"	Call	64-1.5 DP	1-100"
Farnel Engineering (Pvt.) Ltd.	25 mm	150 mm	Call	3.5 module	250 mm
Federal Gear Corporation	500"	24"	AGMA 8	64-.5 DP	135"
First Gear, Inc.	.375"	7.9"	AGMA 10	Call	8.0"
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	Call	Call
Forest City Gear Co.	1/8"	17"	Call	200-3.5 DP	31"
Fuji Univance Corporation	Call	Call	Call	Call	Call
G&N Rubicon Gear Inc.	.125"	36"	AGMA 15	3/8 DP	20"
Gateway Precision Gear, Inc.	1/8"	6"	Call	16 DP	10"
Gear & Branch Inc.	.5"	12"	AGMA 9	Call	Call
Gear Products Company	25 mm	101 mm	AGMA 9	8 module	152 mm
Gear Research Inc.	.125"	12"	AGMA 5-7	3 DP	6"
Gear Tech Inc.	Call	9"	AGMA 8	3 DP	Any
Gear Works, Inc.	.10"	18"	ANSI 5	4-8 DP	10"
The Gear Works Inc.	.5"	6.0"	AGMA 6	32-64 DP	24"
The Gear Works—Seattle, Inc.	1"	96"	AGMA 8	1.0 DP	36"
Gearmakers	1/8"	96"	AGMA 8	.75 DP	120"
Gearsmiths Co.	.5"	36"	AGMA 5	3-4 DP	24"



## GEAR MANUFACTURING DIRECTORY

### SPLINED SHAFTS CONTINUED

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Length
GearTec, Inc.	Call	Call	Call	Call	Call
General Gear Corp.	.75"	6"	AGMA 8	6 DP	16"
Gerhardt Gear Co., Inc.	Call	56"	Call	Call	Call
Griffin Gear	.5"	24"	AGMA 9	1 DP	10"
Hanover Gear Mfg. Co.	Call	Call	AGMA 10	Call	Call
HMC Gear Mfg. and Engineering	6"	72"	AGMA 10	1.0 DP	252"
Holland Gear Works LLC	.5"	36"	Call	3 DP	64"
Holtz Gears & Sprockets	1"	3"	Call	Call	72"
Horsburgh & Scott	Call	Call	Call	Call	Call
HPC Drives Ltd.	14 mm	54 mm	Call	Call	300 mm
Hub City, Inc.	.5"	3"	Call	Call	14"
Hytex Gear Co.	Call	6"	AGMA 10+	12 DP	10"
Indiana Power Transmission Systems	Call	Call	Call	Call	Call
Indiana Tool - Indiana Gear	1"	12"	Call	Call	60"
Industrial Machine & Supply, Inc.	.750"	6"	Call	Call	20"
Industrial Sprockets & Gears Inc.	.500"	24"	AGMA 8	2 DP	19"
Inscor Corporation	Call	Call	Call	Call	Call
Jade Precision Gear	Call	Call	Call	Call	Call
Koro Industries Inc.	1/8"	.5"	Call	20 DP	6"
Kreiter Geartech	Call	Call	Call	Call	Call
Lawler Gear	1"	3"	AGMA 8	4 DP	48"
Lee Tool Co.	.500"	8"	AGMA 10	Call	40"
Lincoln Tool Works, Inc.	.25"	12"	AGMA 8	4 DP	36"
Link Gear & Machine Co.	1"	12"	AGMA 10	Call	Call
Linn Gear Company	Call	Call	Call	Call	Call
Lyon Gear & Machine	1.0"	6.0"	Call	Call	Call
Madison Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Marine Associates	.75"	8"	AGMA 9	Call	36"
Marine Gears International, Inc.	Call	Call	AGMA 10	2.5 DP	30"
Marples Gears, Inc.	.1875"	6"	AGMA 11	8/16 DP	6"
Master Metal Engineering	.125"	8"	AGMA 9	8 DP	16"
Merit Gear Corporation	Call	Call	Call	Call	Call
mG miniGears	Call	Call	Call	Call	Call
Midwest Gear Corporation	Call	20"	Call	1.5 DP	22"
Midwest Gear & Tool, Inc.	.25"	18"	Call	48-2 DP	Call
Modern Gear & Machine, Inc.	.50"	8"	AGMA 8	6 DP	30"
Modified Gear & Spline Inc.	.375"	14.0"	Call	Call	Call
Moore Gear Mfg.	.5"	8"	AGMA 8	4 DP	48"
Moore Machine & Gear, Inc.	.25"	12"	AGMA 8	1 DP	96"
Niagara Gear Corporation	.25"	6"	AGMA 13	Call	20"
Nissei Corp. of America	Call	Call	Call	Call	Call
Nixon Gear Inc.	Call	Call	Call	Call	Call
North Shore Gear and Tool Corporation	.125"	1.5"	AGMA 10	24 DP	6"
O'Brien Gear Company	1"	16"	AGMA 10	1 DP	108"
Ohio Broach & Machine Co.	Call	Call	Call	Call	Call
Oliver Gear, Inc.	1"	36"	Call	3/16 DP	72"
Orlandi Gear Company	.5"	4"	Call	8 DP	36"
Overton Gear & Tool Corporation	Call	Call	Call	Call	Call
Penn Machine Company	2"	16"	AGMA 8	2.5 DP	60"
Pennsylvania Gear Corporation	1"	36"	AGMA 10	1 DP	60"
Perry Technology Corporation	Call	44"	AGMA 10	2 DP	200"
Prager, Inc.	1"	20"	Call	24-3 DP	120"
Precipart Corp.	.060"	6"	AGMA 10	28-220 DP	10"
Precision Gear Co.	Call	36"	Call	Call	Call
Precision Gear Inc.	2"	36"	Call	1-120 DP	16"
Process Gear	Call	Call	Call	Call	Call
Prophet Gear	1/8"	3"	AGMA 10	5-10 DP	144"
The Purdy Corporation	Call	Call	Call	Call	Call
Quality Gear	Call	Call	Call	Call	Call
Quality Gear Mfg.	.125"	12"	CL-4	4 DP	17"
Quality Transmission Components	10 mm	40 mm	JIS 2	Call	500 mm
Rapid Gear	Call	Call	Call	Call	Call
Rawling Gear Inc.	Call	Call	Call	Call	Call
Reliance Gear Corporation	.250"	26"	AGMA 12	Call	40"
RjLink International, Inc.	Call	24"	Call	Call	Call
Ronson Gears Pty. Ltd.	Call	Call	Call	Call	Call
Rush Gears, Inc.	.5"	10"	AGMA 8	Call	6"
Schafer Gear Works, Inc.	.250"	6"	ANSI 5	4 DP	16"
Schwartz Precision Gear Co.	.25"	12"	ANSI 4	64-3 DP	27"
Selector Spline Products Inc.	.500"	8.0"	AGMA 12	Any	40"
Shanthi Gears	Call	Call	Call	Call	Call
Shin Han Precision & Industry	20 mm	400 mm	Call	Call	Call
SIPCO	Call	Call	Call	Call	Call
Springer Company	Call	Call	Call	Call	Call
Stahl Gear & Machine Co.	1"	24"	AGMA 8	1.5 DP	Call
STD Precision Gear & Instrument, Inc.	Call	Call	Call	Call	Call
Stock Drive Products/Sterling Instrument	13 mm	30 mm	Call	Call	1500 mm
Supreme Gear Company	.5"	12"	AGMA 12	Call	12"
TiCo Gauge & Gear	.06"	12"	AGMA 15	4 DP	14"
Titanium Engineering & Mfg.	.3"	9.00"	AGMA 11	15 DP	24"
Transmission Engineering Co. Inc.	Call	Call	Call	Call	Call
Tropelec Inc.	Call	Call	Call	Call	Call
Unicor Inc.	.312"	6"	AGMA 12	4 DP	Call
Unique Power Products, Inc.	.500"	12.000"	ANSI 4	4 DP	8.000"
Valley Gear & Machine Inc.	Call	Call	Call	Call	Call
Von Ruden Mfg. Inc.	.5"	2.0"	Call	8-16 DP	24"
West Industries, Inc.	.5"	12"	ANSI 4	3 DP	40"
Windsor Gear & Drive Inc.	.5"	12"	AGMA 8-13	8 DP	Call
Xtek Inc.	6"	50"	AGMA 6-8	Call	100"
Xtek Mining Services	4"	45"	Call	Call	240"
Zhuhai Intercoumental Pulleys Ltd.	13 mm	120 mm	Call	Call	Call

### SPROCKETS

Company	Min. Dia.	Max. Dia.	QP	DP/Module	
A & A Gear, Inc.	Call	24"	Call	Call	
Accurate Machine & Maintenance, Inc.	3"	60"	Call	Call	
Acme Gear Co., Inc.	Call	Call	Call	Call	
ACR Industries, Inc.	.25"	12.5"	5/8"	Call	
The Adams Company	.75"	24.0"	1.25"	Call	
Adobe Precision Gear, Inc.	1"	60"	2"	Call	
Advanced Jiffy Machine Products Inc.	.5"	16"	Call	Call	
Aerospace Gear Inc.	1"	16"	Call	Call	
Agro Engineers (Gears)	50 mm	2100 mm	3"	Call	
Akron Gear & Engineering	.5"	120"	3"	Call	
All Power-Transmission Inc.	38 mm	406 mm	19 mm	20 module	
Allied Gear Co.	2"	80"	Call	2.5 DP	
Amera Gear Co., Inc.	1"	36"	1.25"	Call	
American Gear & Engineering	1/8"	100"	Call	3 DP	
American Gear, Inc.	.125"	12"	Call	Call	
American Metric Corporation	Call	Call	Call	Call	
American Precision Gear Co.	Call	Call	Call	Call	
Asco Sintering	Call	3"	Call	Call	
Astron Gear	2"	40"	Call	1.5 DP	
Atch-Mont Gear Co., Inc.	1"	72"	2.5"	Call	
Atlas Gear Company	.500"	36.00"	1.00"	Call	
Avon Gear Co.	3.0"	12.0"	.75"	4.0 DP	
AxiDGear	.500"	12.000"	.750"	4 DP	
B & B Gear & Machine Co., Inc.	Any	60"	Any	Call	



# GEAR MANUFACTURING DIRECTORY

## SPROCKETS CONTINUED

Company	Min. Dia.	Max. Dia.	CP	DP/Module
B & R Machine & Gear Corp.	Call	Call	Call	Call
Berg, W.M., Inc.	.375"	18"	.092-500"	32 DP
Boston Gear	Call	Call	Call	Call
Brad Foote Gear Works	4"	75"	Call	0.5 DP
Branko Malisa Inc.	5/16"	8"	3/8"	Call
Brewer Machine & Gear Co.	Call	Call	Call	Call
Browning/Emerson Power Transmission	.75"	64"	3"	Call
Buckeye Gear Co.	Call	6"	.75"	Call
Buffalo Gear, Inc.	.5"	40"	1"	Call
Calicut Engineering Works Ltd.	Call	2500 mm	Call	25 module
Capitol Stampings Corp.	Call	Call	Call	Call
Capstan Atlantic	Call	Call	Call	Call
Cardinal Engineering Company	.5"	3"	Call	Call
Carnes-Miller Gear Co. Inc.	Call	Call	1.25"	Call
C-B Gear & Machine	1"	240"	6"	Call
Chesta Gear/Channel Power Transmission	Call	Call	Call	Call
The Cincinnati Gear Company	Call	Call	Call	Call
Circle Gear & Machine	Call	120"	3"	Call
Clarke Gear Co.	.10"	16.0"	Call	6 DP
Classic Gears & Sprockets	1"	69"	180"	Call
Cloyes Gear	Call	Call	Call	Call
Commercial Gear & Sprocket Co. Inc.	.25"	60"	2"	Call
Custom Machine & Tool Co., Inc.	500"	18.00"	.75"	Call
Dalian Yield Year Chains Transmission Mfg. Co. Ltd.	13.06 mm	647.47 mm	Call	Call
Davall Gear Company Ltd.	10 mm	450 mm	Call	Call
David Brown Group PLC	Call	Call	Call	Call
Dayton Gear	500"	96"	.100"	Call
Delco Gear & Machine	Call	Call	Call	Call
Delphos Machine & Tool, Inc.	Call	Call	Call	Call
Doppler Gear Co.	.25"	36"	Call	Call
East Point Foundry	Call	Call	Call	Call
Ekteko aandrijftechniek BV	25 mm	1025 mm	Call	18 module
Engranes Industriales Rivera, S.A. de C.V.	.300"	85"	4"	25-3 DP
Erlbacher Gear & Machine Works	2"	24"	60-140"	Call
Euclid Universal Corp.	1"	10"	.75"	Call
F.O. Eng.	Call	Call	Call	Call
Fairfield Manufacturing Co., Inc.	4"	36"	Call	Call
Federal Gear Corporation	500"	96"	1"	Call
First Gear, Inc.	.5"	7.9"	Call	Call
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	Call
Forest City Gear Co.	.25"	17"	1/16-1"	Call
Gateway Precision Gear, Inc.	.25"	6"	3/8"	Call
Gear & Broach Inc.	.5"	48.00"	Call	Call
Gear Products Company	2.00"	10.00"	1"	Call
Gear Products, Inc.	Call	Call	Call	Call
Gear Research Inc.	3"	12"	.5"	Call
Gear Tech Inc.	Call	132"	2.5"	Call
Gear Works, Inc.	.10"	18"	Call	Call
The Gear Works—Seattle, Inc.	1"	180"	2.5"	1.0 DP
<b>Gearmakers</b>	.25"	96"	2"	Call
General Gear Corp.	.75"	6"	.25"	Call
Gerhardt Gear Co., Inc.	Call	Call	Call	Call
Great Lakes Industry, Inc.	Call	Call	Call	Call
Griffin Gear	2"	240"	Call	5 DP
Hanover Gear Mfg. Co.	Call	Call	Call	Call
Hansen Machine Corp.	Call	Call	Call	Call
Helsel, Inc.	Call	Call	Call	Call
Holland Gear Works LLC	.5"	36"	Call	Call
Holtz Gears & Sprockets	1"	72"	1/8"	Call
Hystek Gear Co.	Call	6"	Call	12 DP
Indiana Tool—Indiana Gear	1"	36"	6"	Call
Industrial Machine & Supply, Inc.	.750"	36"	Call	1.25 DP
Industrial Sprockets & Gears Inc.	3/16"	240"	3"	Call
<b>Inco Corporation</b>	Call	Call	Call	Call
Intech Corporation	Call	Call	Call	Call
Involute Tooling Corporation	20 mm	600 mm	Call	Call
Jade Precision Gear	Call	Call	Call	Call
Keller Machine Co.	2"	12"	1"	Call
<b>Kreiter Geartech</b>	Call	Call	Call	Call
Lawler Gear	1"	90"	1.5"	Call
Lincoln Tool Works, Inc.	.25"	32"	1.5"	2.5 DP
Link Gear & Machine Co.	1"	18"	Call	Call
Linn Gear Company	Call	96"	Call	Call
Lynn Gear & Machine	1.0"	20.0"	Call	Call
Madison Sprocket & Gear, Inc.	Call	Call	Call	Call
Marples Gears, Inc.	.375"	8"	.5"	Call
Merit Gear Corporation	Call	Call	Call	Call
mG miniGears	Call	Call	Call	Call
<b>Midwest Gear Corporation</b>	Call	92"	3"	Call
Modern Gear & Machine, Inc.	.50"	10"	2"	Call
Moore Gear Mfg.	.5"	90"	1.5"	Call
Moore Machine & Gear, Inc.	.25"	36"	2"	Call
Nixon Gear Inc.	.5"	120"	Call	Call
Nordex, Inc.	500"	6"	.250"	Call
O'Brien Gear Company	2"	166"	3"	1 DP
Ohio Broach & Machine Co.	Call	Call	Call	Call
Oliver Gear, Inc.	1"	72"	4"	Call
Penn Machine Company	4"	72"	1.75"	Call
Pennsylvania Gear Corporation	1"	72"	3"	1 DP
<b>Perry Technology Corporation</b>	Call	44"	3"	2 DP
Phillips-Moldex Company	Call	6"	Call	20-120 DP
PIC Design	1.25"	16"	.25"	Call
Poly Hi Solidar	1"	40"	Call	Call
Prager, Inc.	1"	80"	3.5"	Call
Precision Gears, Inc.	.50"	36"	1.500"	Call
<b>Prerite Corporation</b>	4"	17"	Call	2-8 DP
Productgear	1.0"	60.0"	Call	Call
Prophet Gear	.25"	12"	10"	5/8 DP
Putnam Precision Molding, Inc.	Call	Call	Call	Call
Quality Gear	Call	Call	Call	Call
Quality Gear Mfg.	.125"	26"	1"	Call
Radina - M	30 mm	600 mm	Call	1 DP
Rapid Gear	Call	Call	Call	Call
Rawling Gear Inc.	Call	Call	Call	Call
Reef Gear Mfg.	1"	9"	Call	Call
Reliance Gear Corporation	500"	26"	1"	Call
Rexnord Corporation	Call	Call	Call	Call
RJLink International, Inc.	Call	24"	Call	Call
Romson Gears Pty. Ltd.	Call	Call	Call	Call
Rush Gears, Inc.	.5"	48"	Call	2-64 DP
Schafer Gear Works, Inc.	500"	16"	1.000"	Call
Schwartz Precision Gear Co.	.2"	27"	Call	Call
Seitz Corporation	Call	Call	Call	Call
Selecter Spline Products Inc.	500"	16"	Any	Call
Shanhi Gears	29 mm	1500 mm	6.25 mm	Call
Shin Han Precision & Industry	15 mm	300 mm	Call	Call
Stahl Gear & Machine Co.	1"	200"	2.5"	Call
STD Precision Gear & Instrument, Inc.	Call	Call	Call	Call
Stock Drive Products/Sterling Instrument	10 mm	255 mm	Call	Call



# GEAR MANUFACTURING DIRECTORY

## SPROCKETS CONTINUED

Company	Min. Dia.	Max. Dia.	CP	DP/Module
Stock Gears Inc.	Call	Call		Call
<b>Supreme Gear Company</b>	2"	10"	.25-1"	6-32 DP
Syntec Custom Injection Molders	Call	Call	Call	Call
Tifco Gage & Gear	.5"	12"	Call	Call
Titanium Engineering & Mfg.	1.0"	9.00"	Call	Call
Transmission Engineering Co. Inc.	Call	Call	Call	Call
Trogetec Inc.	Call	Call	Call	Call
Tsubakimoto Chain Co.	120 mm	1700 mm	Call	Call
Unicor, Inc.	.500"	.6"	Call	Call
Union Gear & Sprocket Corp.	.50"	.72"	1.5"	Call
<b>Valley Gear &amp; Machine Inc.</b>	Call	Call	Call	Call
Van ZeeLand Mfg., Inc.	Call	Call	Call	Call
West Industries, Inc.	1.0"	18"	1.50"	Call
Xtek, Inc.	.6"	150"	Call	5 DP
Xtek Mining Services	10"	220"	Call	3/8 DP
Zhubai Intercontinental Pulleys	21.25 mm	1250 mm	Call	Call

## SPUR GEARS

Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
A & A Gear, Inc.	Call	24"	Call	Call	Call
ABA-PGT, Inc.	.100"	4.00"	AGMA 9	12-150 DP	3.00"
Accurate Machine & Maintenance, Inc.	.5"	60"	Call	Call	16"
Acme Gear Co., Inc.	Call	42"	AGMA 10	Call	Call
ACR Industries, Inc.	.25"	21"	AGMA 14	4 DP	12.5"
The Adams Company	.75"	24.0"	AGMA 10	3 DP	Call
Adobe Precision Gear, Inc.	1"	60"	Call	Call	Call
Advance Gear & Machine Corp.	.5"	30"	AGMA 14	Call	Call
Advanced Jiffy Machine Products, Inc.	.5"	16"	Any	Call	7"
Aerospace Gear Inc.	.50 mm	16"	AGMA 10	Call	3"
<b>Agro Engineers (Gears)</b>	50 mm	1800 mm	AGMA 8	20 Module	400 mm
<b>Akron Gear &amp; Engineering</b>	.5"	120"	AGMA 8	1 DP	60"+
Albro Gear & Instrument Inc.	.100"	4.0"	AGMA 11	24 DP	1"
All Power-Transmission Inc.	1.5"	16"	AGMA 8	3/8 DP	48"
Allied Gear Co.	2"	80"	Call	1.25 DP	Call
Amera Gear Co.	1"	36"	AGMA 8	3 DP	6"
American Gear & Engineering	1/8"	100"	AGMA 8	1 DP	36"
American Gear, Inc.	.125"	12"	Call	Call	Call
American Metric Corporation	.5"	24"	AGMA 13	3 DP	13"
American Precision Gear Co.	Call	Call	Call	Call	Call
Ancon Gear & Instrument Corp.	.093"	6"	AGMA 12	3 DP	4"
Arc International	1.000"	27.000"	AGMA 7-11	25-4 DP	12.000"
Arrow Gear Company	1"	20"	Any	Call	Call
<b>Asano America, Inc.</b>	20 mm	600 mm	JIS 5	12 module	300 mm
Asco Sintering	Call	3"	Call	Call	Call
Astron Gear	.5"	72"	AGMA 9	1.25 DP	24"
Aitch-Mont Gear Co., Inc.	1"	72"	AGMA 9	1 DP	18"
Atlas Gear Company	.375"	36.00"	AGMA 12	2.5 DP	16.00"
Avon Gear Co.	1.0"	13.0"	AGMA 10	4.0 DP	6.0"
AxiDGear	.125"	16.000"	AGMA 10	4 DP	8.000"
<b>B &amp; B Gear &amp; Machine Co., Inc.</b>	Any	20"	AGMA 8	3 DP	9"
<b>B &amp; R Machine &amp; Gear Corp.</b>	Call	120"	AGMA 8	Call	Call
Berg, W.M., Inc.	.375"	18"	AGMA 14	12-200 DP	.750"
Boston Gear	.208"	36.00"	AGMA 8	3 DP	3.50"
Brad Froese Gear Works	Call	2"	Call	0.75 DP	Call
Branko Malita Inc.	5/16"	8"	AGMA 14	12 DP	2"
Brewer Machine & Gear Co.	Call	Call	Call	Call	Call
Browning/Emerson Power Transmission	.2"	60"	AGMA 8	2 DP	5"
Buckeye Gear Co.	.06"	6"	AGMA 9	10 DP	6"
Buffalo Gear, Inc.	.5"	40"	AGMA 10	3 DP	10"
Calicut Engineering Works Ltd.	Call	2500 mm	Call	25 module	1200 mm
Capitol Stampings Corp.	Call	Call	Call	Call	Call
Capstan Atlantic	.450"	6.0"	AGMA 9	64-6 DP	2.5"
Cardinal Engineering Company	.5"	3"	AGMA 8	16-72 DP	1"
Carnes-Miller Gear Co. Inc.	Call	Call	AGMA 10	3 DP	8"
C-B Gear & Machine	1"	240"	AGMA 10	Call	50"
Chardam Gear Co.	.5"	16"	AGMA 12	6 DP	Call
Chicago Gear Works	Call	16"	AGMA 10	4 DP	12"
<b>The Cincinnati Gear Company</b>	1"	200"	AGMA 15	.75 DP	72"
Circle Gear & Machine	.5"	120"	AGMA 8	1.25 DP	30"
Clarke Gear Co.	.10"	16"	AGMA 11	8 DP	10"
Classic Gears & Sprockets	1"	69"	AGMA 8	2 DP	24"
Cloyes Gear	Call	Call	Call	Call	Call
Commercial Gear & Sprocket Co. Inc.	.25"	60"	AGMA 10	2 DP	36"
Cotta Transmission Co.	Call	Call	Call	Call	Call
Crown Gear B.V.	Call	Call	Call	Call	Call
Custom Machine & Tool Co., Inc.	.500"	18.00"	AGMA 10	Call	6.00"
Davall Gear Company Ltd.	3 mm	450 mm	Call	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call
Dayton Gear	.500"	96"	AGMA 9	Call	Call
Delco Gear & Machine	Call	Call	Call	Call	Call
Delpbos Machine & Tool	Call	Call	Call	Call	Call
Doppler Gear Co.	.25"	36"	Call	2 DP	Call
East Point Foundry	Call	Call	Call	Call	Call
Ektelo aandrijftechniek BV	25 mm	1025 mm	Call	Call	Call
EMCO Gears, Inc.	.1"	20"	AGMA 12	4 DP	36"
Engranes Industriales Rivera, S.A. de C.V.	.125"	87"	Call	1-20 DP	23"
<b>Erlbacher Gear &amp; Machine Works</b>	2"	12"	AGMA 10	4-20 DP	9"
Euclid Universal Corp.	1/2"	13"	AGMA 8	4 DP	8"
F.O. Eng.	Call	Call	Call	Call	Call
Fairfield Manufacturing	.5"	120"	AGMA 14	20-1 DP	25-56"
Falk Corporation	10"	552"	Call	5 DP	Call
Farel Engineering (Pvt.) Ltd.	25 mm	400 mm	Call	Call	150 mm
Federal Gear Corporation	.500"	103"	AGMA 8	Call	48"
First Gear, Inc.	.437"	7.9"	AGMA 12	4.25 DP	8.0"
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	Call	Call
Fisler Corporation	.75"	110"	AGMA 12	Call	Call
Forest City Gear Co.	1/16"	.17"	AGMA 12	Call	Call
Formosa Heavy Industries Corp.	50 mm	7500 mm	DIN 4	200-3.5 DP	16"
Fuji Univance Corporation	Call	Call	Call	50 module	1800 mm
G&N Rubicon Gear Inc.	.125"	48"	AGMA 15	3/8 DP	10"
Gateway Precision Gear, Inc.	1/8"	6"	AGMA 14	16 DP	10"
Gear & Broach Inc.	.5"	48.00"	AGMA 10	Call	Call
Gear Products Company	1.00"	12.00"	AGMA 9	3 DP	4.0"
Gear Products, Inc.	Call	Call	Call	Call	Call
Gear Research, Inc.	.125"	12"	AGMA 8-12	3 DP	4"
Gear Tech Inc.	Call	132"	AGMA 8	.75 DP	48"
Gear Works, Inc.	.10"	18"	AGMA 10	4 DP	10"
The Gear Works Inc.	.5"	10.0"	AGMA 6	48-3 DP	10"
The Gear Works—Seattle, Inc.	1"	200"	AGMA 10	1.0 DP	36"
<b>Gearmakers</b>	1/8"	96"	AGMA 8	.75 DP	120"
Gearsmiths Co.	Call	Call	Call	Call	Call
GearTec, Inc.	2"	48"	AGMA 10	1.5 DP	Call
General Gear Corp.	.5"	16"	AGMA 8	6 DP	6"
Gerhardt Gear Co., Inc.	Call	Call	Call	Call	Call
Getrag Gears of North America, Inc.	30 mm	250 mm	DIN 8	5 module	60 mm
Great Lakes Industry, Inc.	Call	Call	Call	Call	Call
Great Taiwan Gear Ltd.	Call	Call	Call	Call	Call
Greenspon Engineering Works Ltd.	20 mm	420 mm	ISO 6	Call	Call



# GEAR MANUFACTURING DIRECTORY

SPUR GEARS CONTINUED					
Company	Min. Dia.	Max. Dia.	Quality	DP/Module	Max. Face
Griffin Gear	5"	240"	AGMA 10	5 DP	36"
Hanover Gear Mfg. Co.	Call	Call	AGMA 10	Call	Call
Hansen Machine Corp.	Call	Call	Call	Call	Call
Helsel, Inc.	Call	Call	Call	Call	Call
HMC Gear Mfg. and Engineering	10"	240"	AGMA 12	375 DP	35"
Holland Gear Works LLC	5"	36"	Call	Call	36"
Holtz Gears & Sprockets	5"	Call	Call	Call	14"
Horsburgh & Scott	Call	Call	Call	Call	Call
Hub City, Inc.	5"	20"	AGMA 8-10	Call	3"
Hyeck Gear Co.	Call	6"	AGMA 10+	12 DP	10"
Indiana Power Transmission Systems	1"	14"	Call	Call	Call
Indiana Tool - Indiana Gear	1"	72"	AGMA 10	1.8 DP	15"
Industrial Machine & Supply, Inc.	.625"	36"	Call	2 DP	15"
Industrial Sprockets & Gears Inc.	.500"	20"	AGMA 8	.5 DP	48"
<b>Innovative Rack &amp; Gear Company, Inc.</b>	Call	6"	AGMA 8	12 DP	10"
<b>Inco Corporation</b>	Call	Call	Call	Call	Call
Intech Corporation	Call	Call	Call	Call	Call
Invinible Gear Co	.375"	12"	AGMA 11-15	5 DP	Call
Involute Tooling Corporation	20 mm	800 mm	Call	14 module	150 mm
ITW Spiroid	Call	Call	DIN 6	Call	Call
Jade Precision Gear	Call	Call	Call	Call	Call
Keller Machine Co.	2"	12"	AGMA 8	5 DP	Call
Koro Industries Inc.	.100"	.3"	AGMA 10	20 DP	1"
<b>Kreiter Geartech</b>	Call	Call	Call	Call	Call
Lawler Gear	1"	90"	AGMA 8	2 DP	18"
Lee Tool Co.	.500"	27"	AGMA 10	3-32 DP	4"
Lincoln Tool Works, Inc.	.25"	32"	AGMA 10	2.5 DP	12"
Link Gear & Machine Co.	Call	36"	AGMA 10	Call	Call
Linn Gear Company	1"	96"	Call	1 DP	28"
Lyon Gear & Machine	1.0"	20.0"	Call	Call	Call
Madison Sprocket & Gear, Inc.	Call	Call	Call	Call	Call
Marine Associates	.75"	16"	AGMA 11	3 DP	24"
Marine Gears International, Inc.	Call	96"	AGMA 10	1.75 DP	30"
Marples Gears, Inc.	.063"	8"	AGMA 13	12 DP	6"
Master Metal Engineering	Call	16"	AGMA 10	20 DP	16"
Merit Gear Corporation	Call	Call	Call	Call	Call
mC miniGears	Call	Call	Call	Call	Call
Midwest Gear Corporation	Call	92"	Call	1 DP	24"
Midwest Gear & Tool, Inc.	.25"	18"	Call	48-2 DP	Call
Milwaukee Gear Company	.5"	60"	AGMA 14	48-75 DP	31"
Modern Gear & Machine, Inc.	.25"	32"	AGMA 9	3 DP	15"
Modified Gear & Spine Inc.	.375"	36"	Call	3 DP	Call
Moore Gear Mfg.	.5"	90"	AGMA 8	1.5 DP	18"
Moore Machine & Gear, Inc.	.25"	36"	AGMA 10	1 DP	16"
<b>Niagara Gear Corporation</b>	.25"	13"	AGMA 15	4-50 DP	7"
Nissei Corp. of America	Call	Call	Call	Call	Call
Nixon Gear Inc.	.5"	120"	AGMA 10	Call	Call
Nordex, Inc.	.125"	7"	AGMA 10	16 DP	8"
North Shore Gear and Tool Corporation	.062"	5.5"	AGMA 12	20-180 DP	Call
Northern Tool and Gear Co. Ltd.	30 mm	1200 mm	DIN 3	16 module	600 mm
O'Brien Gear Company	1/4"	166"	AGMA 10	.75 DP	19"
<b>Ohio Broach &amp; Machine Co.</b>	Call	Call	Call	Call	Call
Oliver Gear, Inc.	1"	72"	AGMA 9	1.5 DP	26"
Orlandi Gear Company	1"	6"	AGMA 8	3 DP	7"
Osaka Chain & Machinery, Ltd.	60 mm	470 mm	AGMA 11-12	35 module	1100 mm
Overton Gear & Tool Corporation	2"	39"	AGMA 13	1.5-30 DP	Call
Penn Machine Company	72"	72"	AGMA 8	1 DP	Call
Pennsylvania Gear Corporation	1"	72"	AGMA 13	1 DP	36"
Perry Technology Corporation	Call	44"	AGMA 10	2 DP	8"
Phillips-Moldex Company	Call	6"	AGMA 6-8	20-120 DP	Call
PIC Design	.125"	16"	AGMA 14	8 DP	16"
Poly Hi Solidar	.5"	20"	Call	Call	Call
Prager, Inc.	1"	80"	AGMA 11	48-1 DP	40"
Precipart Corporation	.060"	6"	AGMA 10	28-220 DP	4"
Precision Gear Co.	.1"	36"	AGMA 13	2.5 DP	13"
Precision Gear Inc.	1"	15"	AGMA 10-15	1-48 DP	12"
Precision Gears, Inc.	.25"	36"	AGMA 10	48 DP	36"
<b>Preelite Corporation</b>	.3"	17"	AGMA 7-10	2-8 DP	12"
Process Gear	Call	Call	Call	Call	Call
Productgear	1.0"	60.0"	AGMA 11	Call	Call
<b>Pro-Gear Co., Inc.</b>	.500"	27.5"	AGMA 13	48-3.5 DP	Call
Prophet Gear	1/8"	12"	AGMA 10	5 DP	8"
<b>The Purdy Corporation</b>	Call	Call	Call	Call	Call
Putnam Precision Molding	4"	300"	Call	Call	Call
Quality Gear	Call	Call	Call	Call	Call
Quality Gear Mfg.	.125"	26"	AGMA 5-11	Call	Call
<b>Quality Transmission Components</b>	10 mm	2000 mm	JIS 1	Call	Call
Radina - M	10 mm	1000 mm	Call	10 module	200 mm
Rapid Gear	Call	Call	Call	Call	Call
Rawling Gear Inc.	Call	Call	Call	Call	Call
Reef Gear Mfg.	1"	10"	AGMA 11	Call	Call
Reliance Gear Corporation	.250"	26"	AGMA 13	2 DP	40"
RJLink International, Inc.	Call	24"	Call	Call	Call
Ronson Gears Pty. Ltd.	Call	Call	Call	Call	Call
Roe Machine	Call	38"	Call	2 DP	8"
Rush Gears, Inc.	.5"	48"	AGMA 8	2-64 DP	6"
Schafer Gear Works, Inc.	.250"	16"	AGMA 10	3 DP	16"
Schwartz Precision Gear Co.	.25"	27"	AGMA 13	64-2 DP	8"
Seitz Corporation	Call	Call	Call	Call	Call
Selector Spline Products Inc.	.500"	16.0"	AGMA 8	Call	3.0"
SEW-Components Pie Ltd	50 mm	1000 mm	ISO 6	16 module	300 mm
Shanthi Gears	10 mm	3200 mm	DIN 9	Call	846 mm
SPM	12.0 mm	60.0 mm	AGMA 11	All	14 mm
Springer Company	5"	120"	AGMA 10	Call	Call
Suhl Gear & Machine Co.	5"	200"	AGMA 12	1 DP	Call
STD Precision Gear & Instrument, Inc.	Call	Call	Call	Call	Call
<b>Stock Drive Products/Sterling Instrument</b>	11 mm	186 mm	ISO 5-9	4-3.5 module	2-30 mm
Stock Gears Inc.	Call	Call	Call	Call	Call
Suda International Gear Works	6 mm	2400 mm	DIN 2	24 module	450 mm
<b>Supreme Gear Company</b>	.25"	12"	AGMA 13	2-96 DP	6"
Syntec Custom Injection Molders	.125"	4.7"	AGMA 7	Call	Call
Ta-Tung Gear Co.	Call	Call	Call	Call	Call
Tifco Gage & Gear	.06"	14"	AGMA 15	4 DP	Call
Titanium Engineering & Mfg.	.3"	9.00"	AGMA 11	3 DP	Call
Transmission Engineering Co. Inc.	Call	Call	Call	Call	Call
Trogetec Inc.	Call	Call	Call	Call	Call
Unicor, Inc.	Call	12"	AGMA 12	4 DP	Call
Union Gear & Sprocket Corp.	Call	12"	AGMA 8	2 DP	15"
Unique Power Products, Inc.	.625"	18.000"	AGMA 13	4 DP	8.000"
<b>Valley Gear &amp; Machine Inc.</b>	Call	Call	Call	Call	Call
Van Zeeland Mfg., Inc.	.583"	26"	Call	Call	6"
Von Ruden Mfg. Inc.	.5"	16.0"	AGMA 9	4 DP	6"
Vorpe Microgears Switzerland	Call	1"	AGMA 12	30 DP	Call
Weatherford ALS	2"	60"	AGMA 7	1.5 DP	20"
West Industries, Inc.	.5"	18"	AGMA 12	3 DP	16"
Windsor Gear & Drive Inc.	.375"	12"	AGMA 11-15	5 DP	Call
Wohler Corp	6"	60"	Call	4-14 DP	4"
Xtek, Inc.	6"	216"	AGMA 6-12	.5 DP	30"
Xtek Mining Services	6"	220"	Call	3/8 DP	24"
Zhubai Intercontinental Pulleys	Call	Call	Call	Call	Call



# GEAR MANUFACTURING DIRECTORY

## STRAIGHT & SPIRAL BEVEL GEARS

Company	Str. Dia.	Str. Quality	Str. DP/Mod.	Sp. Dia.	Sp. Quality	Sp. DP/Mod.
A & A Gear, Inc.	1.0-12"	Call	Call	—	—	—
ABA-PGT, Inc.	100-4.00"	AGMA 8	12-96 DP	100-4.00"	AGMA 8	12-96 DP
ACR Industries, Inc.	5-14"	AGMA 11	2.5 DP	25-34"	AGMA 15	2.5 DP
The Adams Company	1.0-14.0"	AGMA 8	3 DP	—	—	—
Advance Gear & Machine Corp.	Call	Call	Call	5-12"	AGMA 11	Call
Akron Gear & Engineering	24" max.	AGMA 8	3 DP	—	—	—
Allied Gear Co.	1-30"	Call	1.5 DP	—	—	—
Amarillo Gear Company	—	—	—	Call	Call	Call
American Gear & Engineering	1-36"	AGMA 8	1 DP Stub	—	—	—
American Gear, Inc.	250-2.5"	Call	Call	—	—	—
American Metric Corporation	Call	Call	Call	Call	Call	Call
American Precision Gear Co.	Call	Call	Call	—	—	—
Arrow Gear Company	1-16"	Any	16 module	1"-28"	Any	Call
Asano America, Inc.	40-420 mm	JIS 4	16 module	40-470 mm	JIS 1	17 module
Asco Sintering Co.	0-3"	Open	Call	—	—	—
Astron Gear	5-40"	AGMA 9	1.5 DP	5-40"	AGMA 9-10	1.5 DP
ATA Gears Ltd.	—	—	—	2-100"	AGMA 14	0.6 DP
Atch-Mont Gear Co., Inc.	1-50"	AGMA 6	1.25 DP	—	—	—
Atlas Gear Company	1.00-22.00"	AGMA 10	3 DP	—	—	—
B & R Machine & Gear Corp.	0-80"	AGMA 8	Call	0-66"	AGMA 8	Call
Berg, W.M., Inc.	375-3.750"	AGMA 14	16-96 DP	—	—	—
Bonfiglioli Riduttori S.p.A.	Call	Call	Call	Call	Call	Call
Boston Gear	250-9.00"	AGMA 8	4 DP	430-4.25"	AGMA 8	8 DP
Brad Foote Gear Works	6-108"	AGMA 8	0.5 DP	6-108"	Call	0.5 DP
Branko Malisa Inc.	5-4"	AGMA 10	Call	—	—	—
Brewer Machine & Gear Co.	Call	Call	Call	—	—	—
Browning/Emerson Power Transmission	5-14"	AGMA 8	3 DP	5-14"	AGMA 8	8 DP
Calcutt Engineering Works Ltd.	Call	Call	Call	—	—	—
Capstan Atlantic	Call	Call	Call	—	—	—
Carnes-Miller Gear Co., Inc.	Call	AGMA 9	8 DP	—	—	—
Caron-Vector	—	—	—	Call	Call	Call
C-B Gear & Machine	1-60"	AGMA 10	1 DP	3-60"	AGMA 10	1 DP
Chenta Gear/Channel Power Transmission	—	—	—	Call	Call	Call
Chicago Gear Works	0-8"	AGMA 8	4 DP	—	—	—
The Cincinnati Gear Company	—	—	—	Call	Call	Call
Circle Gear & Machine	0-48"	AGMA 8	2 DP	—	—	—
Cloyes Gear	Call	Call	Call	—	—	—
Commercial Gear & Sprocket	25-16"	AGMA 10	3 DP	—	—	—
Crown Gear B.V.	18-1100 mm	DIN 6	Call	18-1100 mm	DIN 6	Call
Dalian Yield Year Mfg. Co.	37.4-237 mm	Call	Call	38.8-650.26 mm	Call	Call
Davall Gear Company Ltd.	0-200 mm	Call	Call	0-200 mm	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call	Call
Dayton Gear	75-16"	AGMA 8	3 DP	—	—	—
Delco Gear & Machine	Call	Call	Call	Call	Call	Call
Engines Industrielles Rivera	450-14"	Call	1.5-18 DP	450-24"	Call	1.5-18 DP
F.O. Eng.	Call	Call	Call	Call	Call	Call
Fairfield Manufacturing	1-36"	Call	16-1.25 DP	1-36"	Call	16-1.1 DP
Falk Corporation	10-34"	Call	1 DP	10-34"	Call	1 DP
Farel Engineering (Pvt.) Ltd.	75-150 mm	Call	5 module	—	—	—
Federal Gear Corporation	500-20"	AGMA 8	Call	—	—	—
Fisher's Gear & Machine Co., Inc.	Call	Call	Call	—	—	—
Flender Corporation	Call	Call	Call	1.5-40"	AGMA 12	Call
Formosa Heavy Industries Corp.	—	—	—	Call	Call	Call
Fuji Univance Corporation	Call	Call	Call	Call	Call	Call
G&N Rubicon Gear Inc.	380-16"	AGMA 11	160 DP	850-24"	AGMA 15	36 DP
Gateway Precision Gear, Inc.	3/16-4-7/16"	AGMA 10	10 DP	—	—	—
Gear & Broach Inc.	1.0-8.0"	AGMA 9	Call	—	—	—
Gears & Gear Drives	20-300 mm	DIN 8	2-8 module	—	—	—
Gear Tech Inc.	0-40"	AGMA 6-7	1.5 DP	—	—	—
The Gear Works—Seattle, Inc.	1-54"	AGMA 7	1.0 DP	—	—	—
Gearmakers	3/8-48"	AGMA 8	.75 DP	—	—	—
Getrag Gears of North America, Inc.	—	—	—	100-220 mm	DIN 7	5 module
Greenspoon Engineering Works Ltd.	Call	Call	Call	Call	Call	Call
Griffin Gear	1-63"	AGMA 9	.5 DP	Call	Call	Call
Helvet, Inc.	Call	Call	Call	Call	Call	Call
Hab City, Inc.	5/8-8"	AGMA 8-9	Call	5/8-14"	AGMA 8-10	—
Indiana Power Transmission Systems	Call	Call	Call	—	—	—
Industrial Machine & Supply, Inc.	1-12"	Call	3 DP	—	—	—
Industrial Sprockets & Gears Inc.	2-36"	AGMA 9	1.5 DP	2-36"	AGMA 9	1.5 DP
Intech Corporation	Call	Call	Call	Call	Call	Call
Lawler Gear	1-12"	AGMA 8	4 DP	—	—	—
Link Gear & Machine Co.	1-14"	AGMA 9	Call	3-49"	AGMA 14	Call
Linn Gear Company	1-60"	Call	1 DP	1-60"	Call	Call
M.S. Engineers	Call	Call	Call	750-3.000"	Call	1-2.75 DP
Madison Sprocket & Gear, Inc.	Call	Call	Call	—	—	—
Marine Associates	.625-14"	AGMA 9	2.5 DP	.625-7"	AGMA 9	4 DP
Master Metal Engineering	25-3"	AGMA 9	20 DP	—	—	—
mG miniGears	Call	Call	Call	Call	Call	Call
Midwest Gear & Tool, Inc.	25-18"	Call	48-2 DP	25-18"	Call	48-2 DP
Moore Gear Mfg.	1-16"	AGMA 8	3-24 DP	2-16"	AGMA 8	4 DP
Nissei Corp. of America	Call	Call	Call	Call	Call	Call
Nixon Gear Inc.	0-48"	Call	Call	—	—	—
Nordex, Inc.	.187-4"	AGMA 10	16 DP	—	—	—
Northern Tool and Gear Co. Ltd.	—	—	—	50-800 mm	DIN 8	14 module
O'Brien Gear Company	1-36"	AGMA 10	1 DP	1-36"	AGMA 10	1 DP
Oliver Gear, Inc.	—	AGMA 9	1 DP	—	—	—
Osaka Chain & Machinery, Ltd.	—	—	—	100-2000 mm	AGMA 11-12	45 module
Penn Machine Company	4.0-60"	AGMA 8	.75 DP	—	—	—
Pennsylvania Gear Corporation	1-72"	AGMA 14	1 DP	2-72"	AGMA 14	1 DP
Perry Technology Corporation	0-44"	AGMA 10	2 DP	—	—	—
Phillips-Moldex Company	0-6"	AGMA 6-8	20-120 DP	0-6"	AGMA 6-8	20-120 DP
PIC Design	25-4.5"	AGMA 12	16 DP	—	—	—
Prager, Inc.	Call	Call	Call	—	—	—
Precipart Corporation	.060-6"	AGMA 10	28-220 DP	—	—	—
Precision Gear Co.	0-34"	AGMA 10	1.25 DP	0-8.5"	AGMA 9	4 DP
Presrite Corporation	—	—	—	8-17"	AGMA 7-10	2-8 DP
Productgear	1.0-60.0"	AGMA 11	Call	Call	Call	Call
The Purdy Corporation	Call	Call	Call	Call	Call	Call
Quality Gear	Call	Call	Call	Call	Call	Call
Quality Transmission Components	20-300 mm	JIS 1	Call	20-300 mm	JIS 1	Call
Radina - M	Call	Call	Call	10-900 mm	Call	16 module
Rawling Gear Inc.	Call	Call	Call	Call	Call	Call
Reliance Gear Corporation	500-36"	AGMA 10	2 DP	500-33"	AGMA 13	1.5 DP
Romson Gears Pty. Ltd.	Call	Call	Call	—	—	—
Rush Gears, Inc.	1.00-24"	AGMA 8	2-64 DP	1-10"	AGMA 8	2-64 DP
Seltz Corporation	Call	Call	Call	—	—	—
Selector Spine Products Inc.	1.0-10.0"	AGMA 10	Call	—	—	—
Shanthi Gears	12-1650 mm	DIN 8-9	30 module	0-850 mm	DIN 7-9	16 module
Shin Han Precision & Industry	20-500 mm	Call	Call	30-500 mm	Call	Call
SIPCO	—	—	—	Call	Call	Call
Springer Company	Call	Call	Call	4-102"	AGMA 10	Call
Stahl Gear & Machine Co.	5-54"	AGMA 8	1.25 DP	1-24"	AGMA 8	1.25 DP
Stock Drive Prod/Sterling Instrument	11-136 mm	ISO 8	5-3 module	34-162 mm	ISO 6	4 module
Suda International Gear Works	10-150 mm	DIN 6	5 module	10-1150 mm	DIN 3	15.5 module
Sumitomo Machinery Corp. of America	Call	Call	Call	Call	Call	Call
Supreme Gear Co.	75-12"	AGMA 10	6-32 DP	75-12"	AGMA 13	6-32 DP
Ta-Tung Gear Co.	Call	Call	Call	—	—	—
Transmission Engineering Co. Inc.	Call	Call	Call	Call	Call	Call
Tsubakimoto Chain Co.	Call	Call	Call	—	—	—



# GEAR MANUFACTURING DIRECTORY

## STRAIGHT & SPIRAL BEVEL GEARS CONTINUED

Company	Str. Dia.	Str. Quality	Str. DP/Mod.	Sp. Dia.	Sp. Quality	Sp. DP/Mod.
Union Gear & Sprocket Corp.	750-15"	AGMA 8	2 DP	—	—	—
Von Ruden Mfg. Inc.	1.0-6.0"	AGMA 9	3 DP	1.0-6.0"	AGMA 9	4 DP
Vorpe Microgears Switzerland	0-1"	AGMA 12	30 DP	—	—	—
West Industries, Inc.	5-8.5"	AGMA 10	3-20 DP	5-18"	AGMA 10	2.5 DP
Xtek, Inc.	6-60"	AGMA 6-8	5 DP	—	—	—
Zero-Max, Inc.	Call	Call	Call	—	—	—
Zhubai Intercontinental Pulleys Ltd.	Call	Call	Call	—	—	—

## WORMS & WORMWHEELS

Company	W Dia.	W Length	W Qual.	W DP/Mod.	WV Dia.	WV Qual.	WV Teeth
A & A Gear, Inc.	1.0-6.0"	Call	Call	Call	5-24"	Call	Call
ABA-PGT, Inc.	100-2.00"	3.00"	AGMA 8	12-96 DP	100-4.00"	AGMA 8	10-100
Accurate Machine & Maint.	5-6"	12"	Call	Call	2-16"	Call	Call
Acme Gear Co., Inc.	0-36"	Call	Call	Call	Call	Call	Call
ACR Industries, Inc.	25-2"	2"	AGMA 11	6 DP	5-12.5"	AGMA 11	6-400
The Adams Company	75-6.0"	30.0"	AGMA 11	3 DP	1.0-24.0"	AGMA 8	6-240
Adobe Precision Gear, Inc.	Call	Call	Call	Call	Call	Call	Call
Advance Gear & Machine Corp.	Call	Call	Call	Call	5-27"	AGMA 9	Call
Advanced Jiffy Machine Products	—	—	—	—	5-16"	Any	6+
Aerospace Gear, Inc.	—	—	—	—	2-16"	AGMA 10	6-250
Agro Engineers	25-250 mm	500 mm	AGMA 6	8 module	25-2100 mm	AGMA 8	Any
<b>Akron Gear &amp; Engineering</b>	Call	Call	AGMA 8	3 DP	Call	AGMA 8	Call
All Power-Transmission	—	—	—	—	1.5-16"	AGMA 8	12-128
Allied Gear Co.	1-30"	40"	Call	2 DP	Call	Call	Call
Amera Gear Co.	1-6"	12"	AGMA 8	3 DP	1-36"	AGMA 8	10-300
American Gear & Eng.	1/8-6-1/2"	60"	AGMA 8	2.5 DP	1/8-100"	AGMA 8	Call
American Gear, Inc.	250-1.5"	Call	Call	Call	250-12"	Call	Call
American Metric Corp.	Call	Call	Call	Call	—	—	—
American Precision Gear Co.	Call	Call	Call	Call	Call	Call	Call
Ancon Gear & Instrument	—	—	—	—	250-6"	AGMA 10	Call
Astron Gear	1-6"	36"	AGMA 10	2.5 DP	1.5-28"	AGMA 9	20-120
Atch-Mont Gear Co., Inc.	1-12"	50"	AGMA 9	Call	2-60"	AGMA 8	6-400
Atlas Gear Company	500-10.00"	36.000"	AGMA 12	2 DP	1.00-36.000"	AGMA 10	6-350
AxiDgear	—	—	—	—	500-12.000"	AGMA 10	8-300
B & B Gear & Machine	125-12"	Any	AGMA 8	3 DP	0-20"	Any	Any
<b>B &amp; R Machine &amp; Gear Corp.</b>	0-12"	Call	Call	Call	0-48"	Call	Call
Berg, W.M., Inc.	375-750"	4.125"	AGMA 14	16-48 DP	625-7"	AGMA 14	20-180
Bonfiglioli Riduttori S.p.A.	Call	Call	Call	Call	Call	Call	Call
Boston Gear	333-4.00"	5.00"	AGMA 8	4 DP	156-18.00"	AGMA 8	8-100
Brad Foote Gear Works	—	—	—	—	4-120"	Call	10-100
Branko Malisa Inc.	3/8-5/8"	Call	AGMA 10	16-6 DP	5/8-18"	AGMA 10	Call
Brewer Machine & Gear	Call	Call	Call	Call	Call	Call	Call
Browning/Emerson Pwr Trans	63-4.6"	5.5"	AGMA 8	3 DP	63-16"	AGMA 8	200
Buckeye Gear Co.	—	—	—	—	06-6"	AGMA 9	Call
Buffalo Gear, Inc.	5-12"	36"+	AGMA 12	3 DP	5-40"	Call	6+
Calicut Engineering Works	0-600 mm	9000 mm	Call	25 module	0-2500 mm	Call	Call
Cardinal Engineering Co.	5-3"	Call	AGMA 10	Call	5-3"	AGMA 10	Call
Carnes-Miller Gear Co.	Call	8"	AGMA 10	3 DP	Call	AGMA 10	Call
Caron-Vector	Call	Call	Call	Call	Call	Call	Call
C-B Gear & Machine	1-14"	72"	AGMA 10	1 DP	1-60"	AGMA 10	Call
Chenta Gear/Channel Pwr Trans.	Call	Call	Call	Call	Call	Call	Call
Chicago Gear Works	0-4"	6"	AGMA 10	4 DP	16"	AGMA 10	12-120
<b>The Cincinnati Gear Company</b>	1-6"	276"	Call	Call	1-200"	AGMA 10	Call
Circle Gear & Machine	0-14"	96"	AGMA 12	1.5 DP	0-120"	AGMA 10	Call
Clarke Gear Co.	10-4.0"	Call	AGMA 11	8 DP	50-6.0"	AGMA 11	Call
Commercial Gear & Sprocket	25-12"	72"	AGMA 10	2 DP	25-60"	AGMA 10	6-600
Cone Drive Operations	870-13"	Call	Call	Call	Call	Call	Call
Davall Gear Company Ltd.	Call	Call	Call	Call	10-450 mm	Call	Call
David Brown Group PLC	Call	Call	Call	Call	Call	Call	Call
Dayton Gear	500-14"	Call	AGMA 10	2 DP	500-96"	AGMA 9	Call
Delco Gear & Machine	Call	Call	Call	Call	Call	Call	Call
Delroyd Worm Gear Products	750-14"	Call	Call	Call	3.38-88"	Call	25-360
Doppler Gear Co.	25-6"	Call	Call	4 DP	25-16"	Call	Call
Ekelo aandrijftechniek BV	25-120 mm	Call	Call	8 module	25-1025 mm	AGMA 8	Call
Engraves Industrias Rivera	150-12"	36"	Call	1-20 DP	500-79"	Call	Call
Euclid Universal Corp.	5-5"	Call	AGMA 11	4 DP	1-12"	Call	Call
F.O. Eng.	Call	Call	Call	Call	Call	Call	Call
Fairfield Mfg. Co. Inc.	3-10"	60"	AGMA 9	1.5 DP	6-36"	Call	Call
Federal Gear Corp.	500-12"	Call	AGMA 8	Call	500-72"	AGMA 8	Call
First Gear, Inc.	—	—	—	—	75-7.9"	Call	Call
Fisher's Gear & Machine	Call	Call	Call	Call	Call	—	—
Flender Corporation	25-24"	Call	AGMA 12	Call	1-100"	AGMA 12	Call
<b>Forest City Gear Co.</b>	1/8-13"	30"	AGMA 14	46-3.5 DP	25-17"	AGMA 12-14	3-999
Gateway Precision Gear	3/16-5"	6"	AGMA 12	16 DP	3/8-6"	AGMA 10	6-94
Gear & Branch Inc.	1.0-8.0"	Call	Call	Call	1.0-48.0"	Call	Call
Gear Products Inc.	Call	Call	Call	Call	5-6"	AGMA 8-10	20-60
Gear Research Inc.	—	—	—	—	0-132"	AGMA 6-8	1-900+
Gear Tech Inc.	0-20"	102"	AGMA 6-8	1 DP	10-16"	Call	Call
Gear Works, Inc.	—	—	—	—	1-180"	AGMA 8	Call
The Gear Works—Seattle, Inc.	1-12"	Call	AGMA 8	10 DP	5-96"	AGMA 8	6-300
Gearmakers	3/8-16"	24"	AGMA 8	7.5 DP	—	DIN 8	6-360
Gears & Gear Drives	100-150 mm	1000 mm	DIN 8	5 module	20-350 mm	DIN 8	6-600
Gearsmiths Co.	—	—	—	—	1-48"	AGMA 5	6-600
GearTec, Inc.	Call	Call	Call	Call	Call	Call	Call
General Gear Corp.	5-6"	Call	AGMA 7	Call	2-6"	AGMA 7	Call
Gerhardt Gear Co.	Call	Call	Call	Call	Call	Call	Call
Great Taiwan Gear Ltd.	Call	Call	Call	Call	Call	Call	Call
Greenalpin Engineering Works	Call	Call	Call	Call	20-420 mm	ISO 7	Call
Griffin Gear	5-14"	360"	AGMA 9	5 DP	2-240"	AGMA 9	1-999
Hansen Machine Corp.	Call	Call	Call	Call	Call	Call	Call
HMC Inc.	Call	Call	Call	Call	Call	Call	Call
Holland Gear Works	—	—	—	—	1-36"	Call	Call
<b>Holroyd</b>	Call	Call	Call	Call	Call	Call	Call
Holtz Gears & Sprockets	—	—	—	—	1-14"	Call	Call
Hornburgh & Scott	Call	Call	Call	Call	Call	Call	Call
Hub City, Inc.	Call	5"	Call	Call	2-16"	Call	25-100
Indiana Pwr Trans Syst.	Call	40"	Call	Call	1-32"	Call	Call
Indiana Tool—Indiana Gear	1-12"	12"	AGMA 12	2 DP	1-36"	AGMA 12	1-480
Industrial Machine & Supply	—	—	—	—	1-30"	Call	Call
Industrial Sprockets & Gears	500-12"	120"	AGMA 8	1 DP	500-72"	AGMA 8	10-240
Inseco Corporation	Call	Call	Call	Call	Call	Call	Call
Intech Corporation	Call	Call	Call	Call	Call	Call	Call
Involute Tooling Corporation	20-100 mm	500 mm	Call	5 module	20-600 mm	Call	10-150
Jen Wu Machinery	0-320 mm	1500 mm	AGMA 10	18 module	35-900 mm	AGMA 10	8-300
<b>Koro Industries Inc.</b>	100-625"	2"	AGMA 10	20 DP	—	—	—
Lawler Gear	1-12"	24"	AGMA 8	3 DP	1-24"	AGMA 8	Call
Lee Tool Co.	500-8"	45"	AGMA 10	Call	—	—	—
Lincoln Tool Works	1-12"	24"	AGMA 8	3 DP	1-32"	AGMA 10	6-400
Link Gear & Machine	Call	Call	Call	Call	1-16"	Call	Call
Linn Gear Company	0-12"	48"	Call	Call	0-88"	Call	Call
Madison Sprocket & Gear	Call	Call	Call	Call	Call	Call	Call
Marine Associates	1-6"	18"	AGMA 9	Call	1-13"	AGMA 9	Call
Maples Gears, Inc.	200-1"	1"	AGMA 12	12 DP	200-8"	AGMA 12	6-600
Master Metal Engineering	125-11"	4"	AGMA 8	16 DP	375-6"	AGMA 8	10-40
Modern Gear & Machine, Inc.	50-4"	12"	AGMA 8	6 DP	50-8"	AGMA 8	10-1000
Moore Gear Mfg.	Call	36"	Call	Call	Call	AGMA 8	Call
Moore Machine & Gear	25-12"	96"	AGMA 8	Call	25-36"	AGMA 8	9-400
Nelmech Electronics	0.4"	0.6"	Call	Call	—	—	—



**WORMS & WORMWHEELS CONTINUED**

Company	W Dia.	W Length	W Qual.	W DP/Mod.	WW Dia.	WW Qual.	WW Teeth
Nissei Corp. of America	Call	Call	Call	Call	Call	Call	Call
Nixon Gear Inc.	Call	Call	Call	Call	72"	Call	Call
Nordex, Inc.	.250-2"	Call	AGMA 10	16 DP	.625-6"	AGMA 10	Call
O'Brien Gear Company	.25-15"	100"	AGMA 10	1 DP	25-123"	AGMA 10	Call
Oliver Gear, Inc.	1-9"	60"	Call	3 DP	1-72"	Call	10-500
Penn Machine Company	2.0-12"	36"	AGMA 10	2 DP	4-36"	AGMA 8	Call
Pennsylvania Gear Corp.	1-32"	24"	AGMA 14	1 DP	1-72"	AGMA 13	6+
Perry Technology Corp.	Call	Call	AGMA 10	Call	Call	AGMA 10	Call
Phillips-Moldex Company	0-6"	Call	AGMA 6-8	20-120 DP	0-6"	AGMA 6-8	7-52+
PIC Design	.375-.625"	2"	AGMA 12	24 DP	.25-16"	AGMA 12	3+
Poly Hi Solidur	Call	Call	Call	Call	Call	Call	Call
Prager, Inc.	1-16"	50"	Call	24-1 DP	2-60"	Call	7-200
Precipart Corp.	.060-2"	12"	AGMA 10	28-220 DP	.060-6"	AGMA 10	Call
Precision Gear Co.	Call	Call	Call	Call	Call	Call	Call
Precision Gears, Inc.	.50-6"	8"	AGMA 11	3 DP	.50-24"	AGMA 10	6-400
Process Gear	Call	Call	Call	Call	Call	Call	Call
Productgear	Call	Call	Call	Call	Call	Call	Call
Prophet Gear	1/8-2"	6"	AGMA 10	10 DP	1/8-6"	AGMA 10	Call
Quality Gear	Call	Call	Call	Call	Call	Call	Call
Quality Gear Mfg.	.125-6"	18"	AGMA 5-11	8 DP	.125-26"	AGMA 5-10	4-300
Quality Transmission Comp.	Call	Call	Call	Call	10-400 mm	JIS 0	Call
Radina - M	10-200 mm	1200 mm	Call	20 module	30-650 mm	Call	15-200
Rapid Gear	Call	Call	Call	Call	Call	Call	Call
Rawling Gear Inc.	Call	Call	Call	Call	Call	Call	Call
Reliance Gear Corp.	.500-4"	20"	AGMA 12	4 DP	1-26"	AGMA 10	6-400
Rexnord Corp.	Call	Call	Call	Call	Call	Call	Call
Ronson Gears Pty. Ltd.	Call	Call	Call	Call	Call	Call	Call
Roe Machine	Call	Call	Call	Call	Call	Call	Call
Rush Gears, Inc.	.25-10"	6"	AGMA 8	2-64 DP	5-48"	AGMA 8	Call
Schafer Gear Works	.250-6"	6"	AGMA 8	12 DP	.500-16"	AGMA 8	3-400
Schwartz Precision Gear Co.	.5-8"	27"	AGMA 10	64-4 DP	5-14"	AGMA 10	10-80
Seitz Corporation	Call	Call	Call	Call	Call	Call	Call
Shanthi Gears	10-260 mm	3000 mm	Call	15 module	25-3000 mm	Call	6-125
Shin Han Precision & Ind.	20-500 mm	Call	Call	Call	Call	Call	Call
SIPCO	Call	Call	Call	Call	Call	Call	Call
SPM	7.5-11.5 mm	26 mm	AGMA 7	Call	12.0-28.0 mm	AGMA 11	19-25
Springer Company	Call	Call	Call	Call	60"	Call	Call
Stahl Gear & Machine	.5-30"	144"	AGMA 12	1 DP	.5-200"	AGMA 8	Call
STD Precision Gear & Instrument	Call	Call	Call	Call	Call	Call	Call
Stock Drive Prod/Sterling Inst.	10-50 mm	55 mm	ISO 8	3 module	11-160 mm	ISO 8	18-360
Stock Gears Inc.	Call	Call	Call	Call	Call	Call	Call
Suda International Gear	10-350 mm	1200 mm	DIN 3	25 module	20-1000 mm	DIN 3	Call
Supreme Gear Company	.25-4"	4"	AGMA 10	6-32 DP	2-10"	AGMA 10	8+
Syntec Custom Injection Molders	Call	Call	Call	Call	Call	Call	Call
Ta-Tung Gear Co.	Call	Call	Call	Call	Call	Call	Call
Tifco Gage & Gear	.06-6"	6"	AGMA 12	4 DP	5-12"	AGMA 12	6-120
Transmission Eng. Co. Inc.	Call	Call	Call	Call	Call	Call	Call
Tsubakimoto Chain Co.	Call	Call	Call	Call	Call	Call	Call
Unicor, Inc.	Call	Call	Call	Call	Call	Call	Call
Union Gear & Sprocket	.50-6"	40"	AGMA 8	2 DP	.750-56"	AGMA 8	Call
Vorpe Microgears Switzerland	0-1"	Call	AGMA 10	30 DP	0-2"	AGMA 10	Call
West Industries, Inc.	.5-6"	12"	AGMA 10	4 DP	1.0-16"	AGMA 10	6-200

**OTHER GEAR MFG**

Company	Other
Aero-Mold, Inc.	Custom plastic molded gears.
Akron Gear & Engineering	Herringbone gears 72" max., rebuild gearboxes, max weight 50,000 lbs.
Albro Gear & Instrument Inc.	Custom gear manufacturing.
Alten Engineering	Herringbone 1.25-80", AGMA 7-8, 12-1.25 DP, 22" max. face.
AMC	Planetary gear reducers.
American Gear & Engineering	Silent chain, timing belt pulleys, clutches, ratchets.
Ancon Gear & Instrument	Carbide re-hobbing/skiving.
Asano America, Inc.	Honed Gears, max. dia. 250 mm, JIS 1, 5.0 module.
ATA Gears Ltd.	Hypoid gears 2-100", AGMA 14, 0.6 DP.
Atlas Gear Company	Shaper cut internal and shoulder-type helical gears and splines using adjustable guides (fixed guides aren't required).
B & B Gear & Machine Co., Inc.	Broaching & slotting (12" stroke).
Berg, W.M., Inc.	Custom manufacturing all variations of DP, face width and material.
Buckeye Gear Co.	All types of internal and external broaching.
Buffalo Gear, Inc.	Timing pulleys, broaching.
C-B Gear & Machine	Gear box repair.
Commercial Gear & Sprocket Co. Inc.	Ratchets, jaw clutches, face clutches, etc.
Cunningham Industries	Non-circular, elliptical gears 5-12" diameter.
Custom Machine & Tool Co., Inc.	Timing belt pulleys.
Delphos Machine & Tool, Inc.	Face gears, gear couplings, segments, ratchets, serrations, timing pulleys.
Erlbacher Gear & Machine Works	Gear inspection to 12".
Eurosen Corporation	Custom design gears, foundry, forge, architectural products.
Federal Gear Corporation	Worm gears to 50" center distance max., weight capacity to 12,000 lbs.
First Gear, Inc.	Skiving/hard re-hobbing.
Fuji Univance Corporation	Gear mfg. in our factory in Japan. This site assists our customer testing.
Gateway Precision Gear, Inc.	Fine pitch precision, 200 DP to AGMA 14.
Gear Products Company	Timing belt 14 mm, 8 mm pitch.
Gear Works, Inc.	Gear design & reverse engineering.
Gears & Gear Drives	Mechanical actuators & bevel drive gear box.
Gerhardt Gear Co., Inc.	Gerotors, pump gears, crowned gears, pulleys.
Huffman Corp.	Gear grinding machines.
Ikona Gear Systems	Produce precision specialty gears using new technology, designed to specific client requests.
Industrial Sprockets & Gears Inc.	Cut silent chain sprockets, metric from 1-24 module.
Involute Tooling Corporation	Timing pulleys, shaft mounted gear units, worm gear units.
Keystone Threaded Products	Roll formed worms & worm stock.
Marplex Gears, Inc.	Cut plastic gears and pulleys.
Midwest Gear Corporation	Gear tooth shaving, 6" face, 12" pitch diameter, 2 DP max.
Modern Gear & Machine, Inc.	In-house CNC turning, milling, hobbing, broaching, OD grinding, hob sharpening.
Modified Gear & Spline Inc.	Crown ground gears & splines.
Moore-Addison Company	Nonmetallic/phenolic laminate/plastic gear blanks .5-12" dia., suitable for class 6 gears.
O'Brien Gear Company	Internal shaping/slotting 73" height, 12" stroke, 182" swing.
Ohio Broach & Machine Co.	Production broaching services.
Peerless-Winsmith	Speed reducers, gearmotors, variable speed drives, planetary gear reducers.
Pennsylvania Gear Corporation	Sectors 2-72" diameter, AGMA 14.
Performance Gear Systems, Inc.	Design and manufacture of plastic gearing systems.
PIC Design	Metric gears available in equivalent modules.
Power Transmission Services Inc.	Industrial gearbox and pump repair specialists.
Prager, Inc.	Gearbox remanufacturing and repair.
Quality Gear Mfg.	CNC shaping, hobbing, turning, milling, grinding, thread grinding, broaching.
Radina - M	Unique gears.
RJLink International	Splined shaft broaching.
Schwartz Precision Gear Co.	Complete gear boxes, including housings.
STD Precision Gear & Instrument, Inc.	Ratchets.
Stock Gears Inc.	Pulleys.
Ta-Tung Gear Co.	Timing pulleys, gear pumps, gearmotors, speed reducers.
Tifco Gage & Gear	Master gears, spline gages.
Valley Gear & Machine Inc.	Pinions, cut plastic gears, ring gears, timing pulleys, speed reducers, speed increasers, multi-speed transmissions.
Weatherford ALS	Herringbone (30 degree helix angle only).
Wohler Corp	Gear blanks.



## COMPANY INDEX

Welcome to the Company Index of the 2000 Gear Technology Gear Manufacturing Directory. Use this index to locate the complete contact information for each company listed in the Services Index. Gear Technology advertisers are shown in boldface type responsible for errors of fact or omission. If your company was not listed in this directory, and you would like to be included in the next one, please call 847-437-6604.

### A

**A & A Gear, Inc.**  
1840 County Line Rd. Unit 204  
Huntingdon Valley, PA 19006  
(215) 364-3952  
Fax: (215) 364-3951

**ABA-PGT Inc.**  
1395 Tolland Tpk.  
Manchester, CT 06040  
(860) 643-6340  
Fax: (860) 643-7619  
rpaquet@abapgt.com  
www.abapgt.com

**Accurate Machine & Maintenance, Inc.**  
1228 South Detroit  
Tulsa, OK 74120-4260  
(918) 585-1125  
Fax: (918) 585-1766  
acc1228@aol.com  
www accuratemachinetulsa.com

**Acme Gear Company**  
130 W. Forest Ave.  
Englewood, NJ 07631  
(201) 568-2245  
Fax: (201) 568-0282  
james@acmegear.com  
www.acmegear.com

**ACR Industries, Inc.**  
15375 Twenty-Three Mile Rd.  
Macomb, MI 48042-4000  
(810) 781-2800  
Fax: (810) 781-0152  
sales@acrid.com  
www.acrid.com

**The Adams Company**  
100 East 4th St.  
P.O. Box 268  
Dubuque, IA 52004-0268  
(319) 583-3591  
Fax: (519) 583-8048  
adamsco@mwci.net  
www.theadamscompany.com

**Adobe Precision Gear, Inc.**  
P.O. Box 520  
Carlsbad, NM 88221-0520  
(505) 885-8322  
Fax: (505) 885-1568  
adobe@caverns.com  
www.gears.com

**Advance Gear & Machine Corp.**  
16201 S. Broadway  
P.O. Box 2378  
Gardena, CA 90247-0378  
(213) 770-1951  
Fax: (213) 770-1955  
angston@ix.netcom.com

**Advanced Jiffy Machine Products Inc.**  
#9 Industrial Dr.  
P.O. Box 268  
Monett, MO 65708  
(417) 235-6942  
Fax: (417) 235-7074  
advjiffy@sofnet.com

**Aero Gear**  
1050 Day Hill Rd.  
Windsor, CT 06095-4728  
(860) 688-0888  
Fax: 860-285-8514  
buygears@aerogear.com  
www.aerogear.com

**Aero-Mold, Inc.**  
3355 Steep Hill Dr.  
Harrison, AR 72601  
(870) 741-1155  
Fax: (870) 741-2693  
jdc@alltel.net  
www.aero-mold.com

**Aerospace Gear Inc.**  
4350 N.W. 19th Ave.  
Pompano Beach, FL 33064  
(954) 979-8448  
Fax: (954) 968-9901

**Agro Engineers**  
E-3, Industrial Estate  
324007 Kota, Rajasthan

**India**  
(91) 744-360835  
Fax: (91) 744-450276  
agroengineers@yahoo.com  
http://agngears.tripod.com

**Akron Gear & Engineering**  
501 Morgan Ave.  
Akron, OH 44309  
(800) 258-6608  
Fax: (330) 773-9005  
steve@akrongear.com  
www.akrongear.com

**Albro Gear & Instrument Inc.**  
86L Horseblock Rd.  
Yaphank, NY 11980  
(631) 345-0657  
Fax: (631) 345-0663  
albrogear@pbimail.com  
www.nustart.com/albrogear

**All Power Transmission Inc.**  
3146 Market St.  
Green Bay, WI 54304  
(920) 336-5111  
Fax (920) 336-2690  
apt@allpowertrans.com  
www.allpowertrans.com

**Allied Gear Co.**  
4901 W. Arthington  
Chicago, IL 60644  
(773) 287-8742  
Fax: (773) 287-4720

**Alpha Gear Drives**  
1440 Howard St.  
Elk Grove Village, IL 60007  
Phone: (847) 439-0700  
Fax: (847) 439-0755  
www.alphagear.com

**Alten Engineering Div. of Westernman Co.**  
245 N. Broad St.  
P.O. Box 125  
Bremen, OH 43107  
(800) 338-8265  
Fax: (740) 569-4111  
jfisher@westernmancompanies.com  
www.westernmancompanies.com

**Amarillo Gear Company**  
P.O. Box 1789  
2401 Sundown Ln.  
Amarillo, TX 79105  
(806) 622-1273  
Fax: (806) 622-3258  
amagear@arn.net  
www.amarillogear.com

**AMC**  
42217 Irwin Dr.  
Harrison Twp., MI 48045  
(810) 533-0244  
Fax: (810) 469-4875  
rayos@enprotech.com

**Amera Gear Co. Inc.**  
8828 W. Dean Rd.  
P.O. Box 241246  
Milwaukee, WI 53224  
(414) 354-9666  
Fax: (414) 354-9635

**American Gear & Engineering**  
38200 Abruzzi Dr.  
Westland, MI 48185-3280  
(734) 595-6400  
Fax: (734) 595-0149  
americangear@ameritech.net  
www.americangeareng.com

**American Gear, Inc.**  
910 Swanson  
P.O. Box 156  
Prophetstown, IL 61277  
(815) 537-5111  
Fax: (815) 537-2871  
thomasregister.com/OLC/american\_gear/home

**American Machine & Gear**  
2770 N.W. Industrial  
Portland, OR 97210  
(503) 223-7345  
Fax: (503) 226-3526  
pduffy6616@aol.com

**American Metric Corp.**  
52 Metric Rd.  
Laurens, SC 29360  
(864) 876-2011  
Fax: (864) 876-2630  
service@ametric.com  
www.ametric.com

**American Precision Gear Co.**  
1029 American St.  
P.O. Box 906  
San Carlos, CA 94070  
(650) 595-3664  
Fax: (415) 595-0388  
amgear@pacbell.net  
www.amgear.com

**Ancon Gear & Instrument Corp.**  
149 Verdi St.  
Farmingdale, NY 11735  
(631) 694-5255  
Fax: (631) 694-5056  
info@ancongear.com  
www.ancongear.com

**Anderson-Cook Incorporated**  
17650 E. 15-Mile Rd.  
Fraser, MI 48026  
(810) 293-0800  
Fax: (810) 293-0833  
alambert@andersoncook.com  
www.andersoncook.com

**Arc International**  
10955 Withers Cove Park Dr.  
Charlotte, NC 28270  
(704) 588-1809  
Fax: (704) 588-9921  
gfield@arcinternational.com  
www.arcinternational.com

**Arrow Gear Co.**  
2301 Curtiss St.  
Downers Grove, IL 60515-4055  
(630) 969-7640  
Fax: (630) 969-0253  
glynne@arrowgear.com  
www.arrowgear.com

**Arte Corporation**  
1111 Foster Ave.  
Nashville, TN 37211-4412  
(615) 254-6691  
Fax: 615-254-6656  
sales@artecorp.com  
www.artecorp.com

**ASANO America, Inc.**  
5555 Oakbrook Pkwy.  
Suite 440  
Norcross, GA 30093-2253  
(770) 449-0500  
Fax: (770) 209-0165  
Asano@AsanoAmerica.com  
www.AsanoAmerica.com

**Asco Sintering Co.**  
2540 Garfield Ave.  
Commerce, CA 90040  
(323) 723 5121  
Fax: (323) 888 9968  
info@ascosintering.com  
www.ascosintering.com

**ASI Technologies, Inc.**  
405 Caredean Dr.  
Horsham, PA 19044-1388  
(215) 674-8910  
Fax: (215) 672-1816  
dberlinger@asidrives.com  
www.asidrives.com

**Astron Gear**  
6140 River Rd.  
Hodgkins, IL 60525  
(708) 354-2800  
Fax: (708) 354-2810  
www.astrongear.com

**ATA Gears, Inc.**  
19885 Detroit Road  
Rocky River, OH 44116  
(440) 356-0289  
Fax: (440) 356-0289

**ATA Gears Ltd.**  
P.O. Box 120

**FIN-33101 Tampere  
Finland**  
+(358) 3-2870-111  
Fax: +(358) 3-2870-249  
postmaster@ata-gears.fi  
www.ata-gears.fi

**Atch-Mont Gear Co., Inc.**  
Northampton Industrial Park  
65 Industrial Dr.  
Ivyland, PA 18974  
(215) 355-5146  
Fax: (215) 355-3570  
atchmont@nanc.com  
www.atchmontgear.com

**Atlas Gear Company**  
32801 Edward Ave.  
Madison Heights, MI 48071  
(248) 583-3000  
Fax: (248) 583-3433  
bbouren@atlasgearcompany.com  
www.atlasgearcompany.com

**Avon Gear Co.**  
2770 Research Dr.  
Rochester Hills, MI 48309  
(248) 853-6500  
Fax: (248) 853-1437  
avon@agcoga.com  
www.okubo-gear.com

**AxiD Gear**  
1800 S. Acoma St.  
Denver, CO 80223  
(303) 744-2929  
Fax: (303) 744-6146  
AxiDGear@aol.com

**Ayers Gear & Machine, Inc.**  
702 N. 37th Dr.  
Phoenix, AZ 85009  
(623) 934-6913  
Fax: (623) 937-2775

### B

**B&B Gear & Machine Co., Inc.**  
25 E. Main St.  
New Lebanon, OH 45345  
(937) 687-1771  
Fax: (937) 687-1320  
bbgear@aol.com

**B&R Machine & Gear Corp.**  
P.O. Box 536  
4809 U.S. Highway 45  
Sharon, TN 38255  
(901) 456-2636  
Fax: (901) 456-3073  
www.brgear.com

**Berg, W. M., Inc.**  
499 Ocean Ave.  
E. Rockaway, NY 11518  
(516) 596-1700  
Fax: (516) 599-1068  
maryann.mandrachia@wmborg.com  
www.wmborg.com

**Bonfiglioli Riduttori s.p.a.**  
Via Giovanni XXIII, 7/a  
Lippo di Calderara (BO)  
Bologna 40012  
Italy  
++(39) 51-6473111  
Fax: ++(39) 51-6473106  
bonfiglioli@bonfiglioli.com  
www.bonfiglioli.com

**Boston Gear**  
14 Hayward St.  
Quincy, MA 02190  
(888) 999-9860  
Fax: (617) 479-6238  
info@bosgear.com  
www.bostgear.com

**Brad Foote Gear Works**  
1309 S. Cicero Ave.  
Cicero, IL 60650-1404  
(708) 652-7700  
Fax: (708) 652-4140  
www.bradfoote.com



# COMPANY INDEX

Branko Malisa Inc.  
95 Garfield Ave.  
Copiague, NY 11726  
(631) 225-9741  
Fax: (631) 225-2437

Brewer Machine & Gear Co.  
2820 Clark Ave.  
St. Louis, MO 63103  
(314) 534-4021  
Fax: (314) 534-4026  
*info@brevvertensioner.com*  
*www.brevvertensioner.com*

Browning/Emerson Power Transmission  
620 S. Aurora St.  
Ithaca, NY 14850  
(606) 564-2003 (Marketing Communications)  
Fax: (606) 564-2239 (Marketing Communications)  
*lgermann@emerson-ept.com*  
*www.emerson-ept.com*

Buckeye Gear Co.  
5130 Richmond Rd.  
Cleveland, OH 44146  
(216) 292-6424  
Fax: (216) 292-6454  
*skidmore@earthlink.net*  
*www.buckeyegears.com*

Buffalo Gear, Inc.  
3635 Lockport Rd.  
Sanborn, NY 14132  
(716) 731-2100  
Fax: (716) 731-2553  
*bg3635@aol.com*  
*www.buffalogearinc.com*

Burgess Norton Mfg. Co.  
500 S. Western Ave.  
Geneva, IL 60134  
(630) 232-4100  
Fax: (630) 232-3790  
*tkolson@burgessnorton.com*  
*www.burgessnorton.com*

## C

C.G.M. S.r.l.  
Via Bruno Buozzi, 1/3  
20030 Senago  
Italy  
(39) 02-9980801  
Fax: (39) 02-9985522

Calicut Engineering Works Ltd.  
26A, Camac St.  
Calcutta 700016  
India  
(91) 33-2475693  
Fax: (91) 33-2476072  
*calicut@hotmail.com*

Capitol Stampings Corp.  
3879 N. Richards St.  
Milwaukee, WI 53212  
(414) 963-3500  
Fax: (414) 963-3516  
*csc@capitolstampings.com*  
*www.capitolstampings.com*

Capstan Atlantic  
10 Cushing Dr.  
Wrentham, MA 02093  
(508) 384-3100  
Fax: (508) 384-3196  
*capstan2@aol.com*  
*www.ecapstan.com*

Cardinal Engineering Company  
3541 N. Elston Ave.  
Chicago, IL 60618  
(773) 478-0522  
Fax: (773) 478-3880  
*ekelly@ameritech.net*

Carnes-Miller Gear Co., Inc.  
362 Browns Hill Rd.  
P.O. Box 268  
Locust, NC 28097  
(704) 888-4448  
Fax: (704) 888-4554  
*www.cmgear.com*  
*dan@cmgear.com*

Caron-Vector  
Avenue Eiffel 5  
B-1300 Wavre  
Belgium  
++(32) 10-231-311  
Fax: ++(32) 10-231-336  
*info@caron-vector.be*  
*www.caron-vector.be*

C-B Gear & Machine  
P.O. Box 111278  
Houston, TX 77293-0278  
(281) 449-0777  
Fax: (281) 590-9127  
*sales@cbgear.com*  
*www.cbgear.com*

Chardam Gear Co.  
40810 Brentwood  
Sterling Heights, MI 48310  
(810) 795-8900  
Fax: (810) 795-8908  
*mbrzoska@chardam.com*  
*www.chardam.com*

Chenta Gear/Channel Power Transmission, Inc.  
1275 Bloomfield Ave. Bldg 2-14  
Fairfield, NJ 07004-2708  
(973) 244-1750  
Fax: (973) 244-1746  
*info@chenta.com*  
*www.chenta.com*

Chicago Gear Works  
1805 S. 55th Ave.  
Cicero, IL 60804  
(800) 343-3652  
Fax: (800) 432-7957  
*sales@chicagoearworks.com*  
*www.chicagoearworks.com*

The Cincinnati Gear Company  
5657 Wooster Pike  
Cincinnati, OH 45227  
(513) 271-7700  
Fax: (513) 271-0049  
*cntigear@worldnet.att.net*  
*www.cntigear.com*

Circle Gear & Machine Co., Inc.  
1501 S. 55th Court  
Cicero, IL 60804  
(708) 652-1000  
Fax: (708) 652-1100  
*cirgear@circlegear.com*  
*www.circlegear.com*

Clarke Gear Co.  
8058 Lankershim Blvd.  
North Hollywood, CA 91605  
(818) 768-0690  
Fax: (818) 767-5577  
*clarkegear@earthlink.net*

Classic Gears & Sprockets  
1629 W. Haskel St.  
Appleton, WI 54914  
(920) 731-7658  
Fax: (920) 731-7688  
*classic@ntsnet.net*  
*www.classicgears.com*

The Cleveland Gear Company  
3249 E. 80th St.  
Cleveland, Ohio 44104  
(800) 423-3169  
*sales@clevelandgear.com*  
*www.clevelandgear.com*

Cloyes Gear/Rush Metals Division  
Highway 15 East  
Billings, OK 74630  
(508) 725-3295  
Fax: (508) 725-3217

Commercial Gear & Sprocket Co. Inc.  
618 Washington St.  
E. Walpole, MA 02032  
(508) 668-1073  
Fax: (508) 668-6625  
*commgear@aol.com*  
*www.commercialgear.com*

Cone Drive Operations Inc.  
Division of Textron Inc.  
240 E. 12th St.  
P.O. Box 272  
Traverse City, MI 49685-0272  
(616) 946-8410  
Fax: (616) 946-0235

Cotta Transmission Co  
P.O. Box 5727  
Rockford IL 61125-0727  
(815) 394-7400  
Fax: (815) 394-7428  
*sales@cotta.com*  
*www.cotta.com*

Crown Gear B.V.  
Buursterstraat 200  
Eindhoven-7544 RG

HOLLAND  
++(31) 53-477-3622  
Fax: ++(31) 53-477-9147  
*sales@crowngear.nl*  
*www.crowngear.nl*

Cunningham Industries, Inc.  
102 Lincoln Ave.  
Stamford, CT 06902  
(203) 324-2942  
Fax: (203) 324-6039  
*fred@cunningham-ind.com*  
*www.cunningham-ind.com*

Custom Gear & Machine  
2422 Teagarden St.  
San Leandro, CA 94577  
510-895-9985  
Fax: 510-895-5417

Custom Machine & Tool Co., Inc.  
22 Station St.  
P.O. Box 890040  
East Weymouth, MA 02189  
(800) 355-5949  
Fax: (800) 355-4490  
*sales@cmtool.com*  
*www.cmtool.com*

Dalian Yield Year Chains Transmission Mfg. Co.  
3320 No. 581 Xinan Rd., Shahekou,  
Dalian, P.R. of China  
+86-411-4208008 4208800  
Fax: +86-411-4208100 4201336  
*yield@mail.dlptt.cn*  
*www.yield.com.cn*

Davall Gear Co. Ltd.  
Welham Green  
Hatfield, Hertfordshire AL9 7JB  
United Kingdom  
++(44) 1707-283100  
Fax ++(44) 1707-283111  
*info@davall.co.uk*  
*www.davall.co.uk*

David Brown Group PLC  
Park Rd., Lockwood  
Huddersfield, West Yorkshire  
HD4 5DD  
United Kingdom  
++(44) 1484-465500  
Fax ++(44) 1484-465501  
*info@davidbrown.com*  
*www.davidbrown.com*

Dayton Gear  
500 Fame Rd.  
Dayton, OH 45449  
(937) 866-4327  
Fax: (937) 866-0408  
*dgear@rcinet.com*  
*www.daytongear.com*

Delco Gear & Machine  
3202 E. 70th St.  
N. Long Beach, CA 90805  
(562) 634-9918  
Fax: (562) 634-0358  
*james@delcogear.com*

Delphos Machine & Tool, Inc.  
4239 Hoover Ave.  
Dayton, OH 45417  
(937) 268-6821  
Fax: (937) 268-6245

Delroyd Worm Gear Products/Nuttall Gear  
2221 Niagara Falls Blvd.  
Niagara Falls, NY 14302  
(800) 432-0121  
Fax: (716) 731-9329  
*nuttall@nuttallgear.com*

Doppler Gear Co.  
2715 29th Ave. South  
Minneapolis, MN 55406  
(612) 729-8301  
Fax: (612) 729-8302  
*sales@dopplergear.com*  
*www.dopplergear.com*

Dorris Company  
8610 Page Ave.  
Saint Louis, MO 63114-6183  
(314) 423-7300  
Fax: (314) 423-8083  
*info@dorrisco.com*  
*www.dorrisco.com*

## E

East Point Foundry  
P.O. Box 90238  
East Point, GA 30344  
(404) 762-1737  
Fax: (404) 762-1738  
*caster@mindspring.com*

Eickhoff Corporation  
200 Park West Dr.  
Pittsburgh, PA 15275  
(412) 788-1400  
Fax: (412) 788-4100  
*www.eickhoffcorp.com*

Ektelo aandrijftechniek BV  
Postbus 541  
7600 AM Almelo  
Netherlands  
(31) 546-576120  
Fax: (31) 546-576155  
*hildering@ektelo.com*  
*www.ektelo.com*

Ellwood Texas Forge  
12500 Amelia Dr.  
Houston, TX 77045  
(713) 434-5101  
Fax: (713) 434-5157  
*mkelley@etf.ellwood.com*  
*www.ellwoodtexasforge.com*

Emco Gears, Inc.  
4329 N. Kedzie Ave.  
Chicago, IL 60618  
(773) 539-1315  
Fax: (773) 539-8792  
*www.emco-gears.com*

Emerson Power Transmission  
620 S. Aurora St.  
Ithaca, NY 14850  
(606) 564-2003 (Marketing Communications)  
Fax: (606) 564-2239 (Marketing Communications)  
*lgermann@emerson-ept.com*  
*www.emerson-ept.com*

Engranes Industriales Rivera, S.A. de C.V.  
Poniente 128 # 389  
Col. Nueva Vallejo  
07750 Mexico City, D.F. Mexico  
(52) 5-587-8266  
Fax: (52) 5-368-3432  
*eirsa@compuserve.com*  
*www.eirsa.com*

Erbacher Gear & Machine Works  
425 Good Hope  
Cape Girardeau, MO 63703  
(573) 334-4040  
Fax: (573) 334-2224  
*jamie@erbachergear.com*  
*www.erbachergear.com*

Euclid Universal Corp.  
7280 Wright Ave.  
Bedford, OH 44146  
(440) 439-6970  
Fax: (440) 439-5613  
*euclidu@ix.netcom.com*  
*www.eucliduniversal.com*

Eurosen Corporation  
3971 Mainsail Ct.  
Duluth, GA 30096-5281  
(770) 622-3800  
Fax: (240) 250-4082  
*eurosen@yahoo.com*  
*www.eurosen.com*

## F

F.O. Eng.  
58 Elmoustaen St.  
21131 Elhadara Elkhebla  
Alexandria  
Egypt  
*moh799@yahoo.com*

Fairfield Manufacturing Co., Inc.  
U.S. 52 South  
P.O. Box 7940  
Lafayette, IN 47903-7940  
(765) 772-4000  
Fax: (765) 772-4010  
*skubik@fairfieldmfg.com*  
*www.fairfieldmfg.com*

Falk Corporation  
3001 W. Canal St.  
Milwaukee, WI 53208  
(414) 342-3131  
Fax: (414) 937-4359  
*falkinfo@falkcorp.com*



# COMPANY INDEX

www.falkcorp.com

Farrell Engineering (Pvt.) Ltd.  
16, Mezzanine Floor, Avanti Terrace  
148-A, Block-2, Allama Iqbal Rd.  
Karachi, Pakistan 4539308  
Fax: 4541069  
hanifpanja@usa.net

Federal Gear Corporation  
38134 Western Pkwy.  
Cleveland, OH 44094  
(440) 946-4327  
Fax: (440) 946-8018  
thefas@aol.com  
www.thomasregister.com/olc/fedgear

First Gear, Inc.  
7606 Freedom Way  
Fort Wayne, IN 46818  
(219) 490-3238  
Fax: (219) 490-4093  
Greg@First-Gear.com  
www.first-gear.com

Fisher's Gear & Machine Co., Inc.  
1201 S. Santa Fe Ave.  
Los Angeles, CA 90021  
(213) 624-7554  
Fax: (213) 624-5729

Flender Corporation  
950 Tollgate Rd.  
Elgin, IL 60123  
(847) 931-1990  
Fax: (847) 931-0711  
sales@flenderusa.com  
www.flenderusa.com

Forest City Gear Co.  
11715 Main St.  
P.O. Box 80  
Roscoe, IL 61073-0080  
(815) 623-2168  
Fax: (815) 623-6620  
fyoung@fcgear.com  
www.fcgear.com

Formosa Heavy Industries Corp.  
13957 Carmel Ridge Rd.  
San Diego, CA 92128-4306  
(858) 618-1414  
Fax: (858) 618-5473  
Formosa\_Heavy\_Industries@compuserve.com

Fuji Univalence Corporation  
N.A. Engineering & Product Support  
3101 First Ave. North  
Fargo, ND 58102-3005  
(701) 280-9548  
Fax: (701) 280-1353  
univalence\_fargo@msn.com

## G

G&N Rubicon Gear Inc.  
1550 E. McFadden Ave.  
Santa Ana, CA 92705  
(714) 835-0326  
Fax: (714) 973-2350  
medwards@gnrubicon.com  
www.gnrubicon.com

Gajra Bevel Gears Ltd.  
Station Rd.  
Dewas, Madhya Pradesh 455 001  
INDIA  
++(91) 7272-75597  
Fax: ++(91) 7272-75596 (factory)

Gateway Precision Gear, Inc.  
111 Algana Cl.  
St. Peters, MO 63376  
(314) 939-4327  
Fax: (314) 939-9878  
gpggear@prodigy.net

Gear & Brouch, Inc.  
7204 Winnetka Ave.  
Brooklyn Park, MN 55428  
(612) 533-0672  
Fax: (612) 533-0461

Gear Motions, Inc.  
—See Nixon Gear, Oliver Gear & Rawling Gear

Gear Products Company  
4956 S. Lawndale Ave.  
Chicago, IL 60632  
(773) 735-4846

Gear Products, Inc.  
1111 N. 161st East Ave.  
Tulsa, OK 74116

(918) 234-3044  
Fax (918) 234-3455  
info@gearproducts.com  
www.gearproducts.com

Gear Research, Inc.  
4329 Eastern Ave. South East  
Grand Rapids, MI 49518  
(616) 241-3411  
Fax: (616) 241-4317  
rick@gearresearch.com

Gear Tech Inc.  
2201 Talley Way  
Kelso, WA 98626  
(360) 577-9178  
Fax: (360) 577-8642  
gears4u@juno.com

Gear Works, Inc.  
304 Paddock Rd.  
Springfield, VT 05156  
(802) 885-5039  
Fax: (802) 885-5176  
gwi@vermontel.com  
www.vermontel.net/~gwi

The Gear Works Inc.  
203 White Park Dr., Suite 1A  
Dallas, GA 30132  
(770) 505-7200  
Fax: (770) 505-7222  
donpowell@earthlink.net

The Gear Works—Seattle, Inc.  
500 S. Portland St.  
Seattle, WA 98108  
(206) 762-3333  
Fax: (206) 762-3704  
tgw@thegearworks.com  
www.thegearworks.com

Gearmakers  
634 New Market Dr.  
Souderton, PA 18964  
(215) 703-0390  
Fax: (215) 703-0391  
www.gearmakers.com

Gears & Gear Drives  
#585, 1st Stage, Indiranagar  
Syndicate Bank Rd.  
Bangalore, Ka 560038  
India  
(91) 80-5281306  
Fax: (91) 80-5283584  
gears@vsnl.com  
http://business.vsnl.com/powerttransmission

Gearsmiths Co.  
10020 Prospect, Suite 20B  
Santee, CA 92071  
(619) 562-0843  
Fax: (619) 562-0843

GearTec, Inc.  
4245 Hamann Pkwy.  
Willoughby (Cleveland), OH 44094-5623  
(440) 953-3900  
Fax: (440) 953-3906  
sales@geartecinc.com  
www.geartecinc.com

General Gear Corp.  
21986 Schmeeman  
Warren, MI 48089  
(810) 779-9393  
Fax: (810) 779-9397

Gerhardt Gear Co., Inc.  
3060 N. California St.  
Burbank, CA 91504-2004  
(818) 842-6700  
Fax: (818) 842-1458  
gears@gerhardtgear.com  
www.gerhardtgear.com

Getrag Gears of North America, Inc.  
1848 Getrag Pkwy.  
Newton, NC 28658  
(828) 428-3711  
Fax: (828) 428-3784  
www.getrag.de

Great Lakes Industry, Inc.  
P.O. Box 6219  
Jackson, MI 49204  
(517) 784-3153  
Fax: (517) 784-3154  
gli@greatlakesind.com  
www.greatlakesind.com

Great Taiwan Gear Ltd.  
115 Bendingwood Circle

Taylor's, SC 29687  
(864) 322-1266  
Fax (864) 609-5268  
greattaiwangear@worldnet.att.net

Greenshpon Engineering Works Ltd.  
20 Haamelim St.  
P.O. Box 10108  
Haifa Bay 26110  
Israel  
++(972) 4-8721187  
Fax ++(972) 4-8726231  
sales@greenshpon.com  
www.greenshpon.com

Griffin Gear  
P.O. Box 890  
Spartanburg, SC 29304  
(800) 423-7506  
Fax: (864) 574-6775  
sales@griffingear.com  
www.griffingear.com

Haley Marine Gears  
—See Marine Gears International, Inc.

Halifax Rack & Screw Cutting Co. Ltd.  
Armytage Rd.  
Brighouse HD6 1QA  
United Kingdom  
(44) 1484-714667  
Fax: (44) 1484-712532  
info@hrs-ccl.co.uk  
www.hrs-ccl.co.uk

Halifax Rack & Screw Cutting Co.  
235 Ben Haven Dr.  
Maysville, KY 41056  
(606) 563-8772  
Fax: (606) 564-8299  
www.hrs-ccl.co.uk

Hanover Gear Mfg. Co.  
300 Fame Ave.  
Hanover, PA 17331  
(717) 632-8977  
Fax: (717) 632-2743  
gearstoday@aol.com

Hansen Machine Corp.  
4502 B Street N.W.  
Auburn, WA 98001  
(253) 854-2995  
Fax: (253) 854-2174

Helsel Inc.  
596 W. Oak St.  
P.O. Box 68  
Campbellsburg, IN 47108  
(812) 755-4501  
Fax: (812) 755-4298  
ewheeler@helselinc.com  
www.helselinc.com

HMC Gear Manufacturing & Engineering  
RR#1, Box 208A  
Princeton, IN 47670  
(812) 385-3639  
Fax: (812) 385-8186  
sales@hmcgears.com  
www.hmcgears.com

Holland Gear Works LLC  
13939 Whitney Rd.  
Holland, NY 14080  
(716) 457-3895  
Fax: (716) 457-4138

Holroyd  
Harbour Ln. North  
Milton, Rochdale OL16 3LQ  
United Kingdom  
(44) 1706 526590  
Fax: (44) 1706 353350  
steven.whitehead@holroyd.com  
www.holroyd.com

Holtz Gears & Sprockets  
2738 S. 29th St.  
Milwaukee, WI 53215-3610  
(414) 645-3891  
Fax: (414) 645-3891

Horsburgh & Scott  
5114 Hamilton Ave.  
Cleveland, OH 44114-3985  
(216) 431-3900  
Fax: (216) 432-5850  
drives@horsburgh-scott.com  
www.horsburgh-scott.com

Hub City, Inc., a Subsidiary of Regal-Beloit Corp.  
2914 Industrial Ave.  
P.O. Box 1089  
Aberdeen, SD 57402-1089  
(605) 225-0360  
Fax: (605) 225-0567  
hcfacts@hubcityinc.com  
www.hubcityinc.com

Huffman Corp.  
1050 Huffman Way  
Clover, SC 29710  
(803) 222-4561  
Fax: (803) 222-7599  
huffman@huffmancorp.com  
www.huffmancorp.com

Hytek Gear Co.  
9820 Owensmouth Ave., #5  
Chatsworth, CA 91311  
(818) 998-5001  
Fax: (818) 998-5001

Ikona Gear Technology Inc.  
5830 Granville St.  
Vancouver, BC V6M 3C7  
Canada  
(604) 618-3435  
Fax: (604) 618-3437

Indiana Power Transmission Systems, Inc.  
470 E. Northfield Dr.  
Brownsburg, IN 46112  
(317) 852-4500  
Fax: (317) 852-6868  
ipt@iquest.net

Indiana Tool—Indiana Gear  
6100 Michigan Rd.  
Plymouth, IN 46563  
(219) 936-2112  
Fax: (219) 936-7224  
dkneidig@itamco.com  
www.itamco.com

Industrial Machine & Supply, Inc.  
101 Costner St.  
Talladega, AL 35160  
(800) 553-3342  
Fax: (256) 362-0041

Industrial Sprockets & Gears Inc.  
13650 E. Rosecrans Ave.  
Santa Fe Springs, CA 90670  
(800) 984-3277  
Fax: (562) 921-4699

Innovative Rack & Gear Company, Inc.  
450 Frontier Way  
Bensenville, IL 60106  
(630) 766-2652  
Fax: (630) 766-3245  
gearack@aol.com  
www.smisco.com

Inso Corporation  
412 Main St.  
Groton, MA 01450  
(978) 448-6368  
Fax: (978) 448-5155  
brucec@insocorp.com  
www.insocorp.com

Intech Corporation  
250 Herbert Ave.  
Closter, NJ 07624  
(201) 767-8066  
Fax: (201) 767-7797  
www.intechpower.com

Invincible Gear Co.  
11970 Mayfield Ave.  
Livonia, MI 48150  
(734) 421-4620  
Fax: (734) 421-6132  
invinciblegearco@ameritech.net

Involute Eng. Inc.  
1396 Winford Ave.  
Ventura, CA 93004  
(805) 659-3321  
Fax: (805) 647-8321  
lojas2@jetlink.net

Involute Tooling Corporation  
13 Jorbagh  
New-Delhi 110003  
India  
(91) 11-4621453  
Fax: (91) 11-4603609  
involute@vsnl.com  
www.involutetools.com



ITW Spiroid  
3700 W. Lake Ave.  
Glenview, IL 60025  
(800) 253-7940  
Fax (847) 657-5098  
[www.itwspiroid.com](http://www.itwspiroid.com)



**J**

Jade Precision Gear  
3501-B 8th Ave. South  
St. Petersburg, FL 33711  
(727) 327-2123  
Fax (727) 323-4403  
[universal1@earthlink.net](mailto:universal1@earthlink.net)



**K**

Keller Machine Co.  
315 N. Leavitt St.  
Chicago, IL 60612  
(312) 421-5283  
Fax: (312) 421-4102

Keystone Threaded Products  
7621 Old Rockside Rd.  
P.O. Box 31059  
Independence, OH 44131-0059  
(216) 524-9626  
Fax: (216) 524-7132  
[jkrejci@keystonethreaded.com](mailto:jkrejci@keystonethreaded.com)  
[www.keystonethreaded.com](http://www.keystonethreaded.com)

Kleiss Gears, Inc.  
5828 Buffalo Lane  
Shoreview, MN 55126  
(651) 792-1081  
Fax: (651) 792-1084  
[kleiss@kleissgears.com](mailto:kleiss@kleissgears.com)  
[www.kleissgears.com](http://www.kleissgears.com)

Koellmann Gear Corp.  
P.O. Box 101  
8 Industrial Park  
Waldwick, NJ 07463-0101  
(201) 447-0200  
Fax: (201) 447-6595  
[sales@koellmann.com](mailto:sales@koellmann.com)  
[www.koellmann.com](http://www.koellmann.com)

Koro Industries Inc.  
9530 85th Ave. North  
Maple Grove, MN 55445  
(612) 425-5247  
Fax: (612) 425-5261  
[steve@karoid.com](mailto:steve@karoid.com)  
[www.karoid.com](http://www.karoid.com)

Kreiter Geartech  
2530 Garrow St.  
Houston, TX 77003  
(713) 237-9793  
Fax: (713) 237-1209  
[kreiter@kreiter-geartech.com](mailto:kreiter@kreiter-geartech.com)  
[www.kreiter-geartech.com](http://www.kreiter-geartech.com)



**L**

L.M. Gear Company  
50550 Russell Schmidt Blvd.  
Chesterfield, MI 48051-2451  
(810) 949-6800  
Fax: (810) 949-9003

Lawler Gear  
1320 S.E. Hamblen Rd.  
Lee's Summit, MO 64081  
(816) 525-0002  
Fax: (816) 525-1113  
[Lawler@Discovery.net](mailto:Lawler@Discovery.net)

Lee Tool Co.  
4603 W. Fullerton  
Chicago, IL 60639  
(773) 772-5762  
Fax: (773) 772-5653

Lincoln Tool Works, Inc.  
2501 S. American Ln.  
Elk Grove Village, IL 60007  
(847) 766-2656  
Fax: (847) 766-3061

Link Gear & Machine  
3101 Falls Cliff Rd.  
Baltimore, MD 21211  
(410) 467-0878  
Fax: (410) 467-6891  
[link@linkgear.com](mailto:link@linkgear.com)  
[www.linkgear.com](http://www.linkgear.com)



Linn Gear Co.  
100 N. 8th St.  
Lebanon, OR 97355  
(541) 259-1211



Fax: (541) 259-1299  
[donf@limgear.com](mailto:donf@limgear.com)  
[www.limgear.com](http://www.limgear.com)

Lyon Gear & Machine  
4371 Territorial Rd.  
Rochester, MI 48306  
(248) 651-1751  
Fax: (248) 651-6548

**M**

M.S. Engineers  
A/2 Raghuvir Estate, Atika Industrial Area  
Dheber Rd. (South)  
Rajkot, GU 360 002  
India  
(91) 281-365236  
Fax: (91) 281-365236  
[msengineers@rajkotonline.com](mailto:msengineers@rajkotonline.com)  
[www.cncw.com/mse](http://www.cncw.com/mse)

Madison Sprocket & Gear, Inc.  
275 Goffle Rd.  
Hawthorne, NJ 07506  
(973) 427-4489  
Fax: (973) 427-5804

Marine Associates  
1651 Hanley Rd.  
Hudson, WI 54016  
(800) 544-1487  
Fax: (715) 386-5357  
[mark@marineassociates.com](mailto:mark@marineassociates.com)

Marine Gears International, Inc.  
600 Concord  
Belle Chasse, LA 70037  
(504) 394-4431  
Fax: (504) 394-1460

Marples Gears, Inc.  
728 W. Santa Anita St.  
San Gabriel, CA 91776  
(626) 570-1744  
Fax: (626) 570-9286  
[www.marplesgears.com](http://www.marplesgears.com)

Martin Sprocket & Gear, Inc.  
3100 Sprocket Dr.  
Arlington, TX 76015  
(817) 258-3000  
Fax: (817) 258-3333  
[mail@martinsprocket.com](mailto:mail@martinsprocket.com)  
[www.martinsprocket.com](http://www.martinsprocket.com)



Master Metal Engineering  
4520 Burnett Dr.  
South Bend, IN 46615  
(219) 299-0222  
Fax: (219) 299-1187  
[www.mastermetal.net](http://www.mastermetal.net)

Merit Gear Corporation  
810 Hudson St.  
Antigo, WI 54409  
(800) 756-3748  
Fax (715) 623-2290  
[meritgear@wi.net](mailto:meritgear@wi.net)  
[www.meritgear.com](http://www.meritgear.com)



Metal Ceramics  
9306 W. Belmont  
Franklin Park, IL 60131  
(847) 678-2293  
Fax: (847) 678-2368

Metal Improvement Co. Inc.  
10 Forest Ave.  
Paramus, NJ 07652  
(201) 843-7800  
Fax: (201) 843-3460  
[jamesdaly@metalimprovement.com](mailto:jamesdaly@metalimprovement.com)  
[www.metalimprovement.com](http://www.metalimprovement.com)

mG miniGears Inc.  
500 E. Main St., #1226  
Norfolk, VA 23510  
(757) 627-4554  
Fax: (757) 627-0944  
[mg\\_usa@minigears.com](mailto:mg_usa@minigears.com)  
[www.minigears.com](http://www.minigears.com)

Midwest Gear & Tool, Inc.  
12024 E. Nine Mile Rd.  
Warren, MI 48089  
(810) 754-8923  
Fax: (810) 754-8926

Midwest Gear Corp.  
2182 E. Aurora Rd.  
Twinsburg, OH 44087  
(330) 425-4419  
Fax: (330) 425-8600  
[ronh@mwgear.com](mailto:ronh@mwgear.com)

Mikkron Ag Hoh Ltd.  
3115, Industrial Area II  
Chandigarh, UT 160002  
India  
(91) 172-653217  
Fax: (91) 172-652384  
[isomet@i91.com](mailto:isomet@i91.com)  
[www.isometindia.com](http://www.isometindia.com)

Milwaukee Gear Company  
5150 N. Port Washington  
Milwaukee, WI 53217  
(414) 962-3532  
Fax: (414) 962-2774  
[www.milwaukeegear.com](http://www.milwaukeegear.com)



Modern Gear & Machine, Inc.  
406 Evergreen St.  
Bensenville, IL 60106  
(630) 350-9173  
Fax: (630) 350-1607  
[darick@moderngear.com](mailto:darick@moderngear.com)  
[www.moderngear.com](http://www.moderngear.com)

Modern Industries, Inc.  
P.O. Box 399  
613 W. 11th St.  
Erie, PA 16512  
(800) 952-4516  
Fax: (814) 453-4382  
[davel@mi-erie.com](mailto:davel@mi-erie.com)  
[www.mi-erie.com](http://www.mi-erie.com)

Modified Gear & Spline Inc.  
18300 Mt. Elliott  
Detroit, MI 48234  
(313) 893-3511  
Fax: (313) 893-6110

Moore-Addison Company  
518 Factory Rd.  
Addison, IL 60101  
(630) 543-6744  
Fax: (630) 543-2805

Moore Gear & Manufacturing Co., Inc.  
#2 Hawthorne Dr.  
P.O. Box 49  
Hermann, MO 65041-0049  
(573) 486-5415  
Fax: (573) 486-3487  
[mooregear@kits.net](mailto:mooregear@kits.net)  
[www.mooregear.com](http://www.mooregear.com)

Moore Machine & Gear, Inc.  
10920 N. St. Joseph Ave.  
Evansville, IN 47720  
(812) 963-3074  
Fax: (812) 963-8212

Mr. Gears, Inc.  
880 Hurlingame  
Redwood City, CA 94063  
(650) 364-7793  
Fax: (650) 364-5083  
[jack@mrgears.com](mailto:jack@mrgears.com)  
[www.mrgears.com](http://www.mrgears.com)

MRA Industries  
—see Anderson Cook

**N**

Nelniech Electronics  
563 Red Bridge Rd.  
Ellsworth, ME 04605  
(207) 667-6893  
[bohn@acadia.net](mailto:bohn@acadia.net)  
<http://server17.hypermart.net/renelectronics/index>

Niagara Gear Corp.  
941 Military Rd.  
Buffalo, NY 14217-2590  
(716) 874-3131  
Fax: (716) 874-9003  
[info@niagaragear.com](mailto:info@niagaragear.com)  
[www.niagaragear.com](http://www.niagaragear.com)



Niranjan Engineering Co.  
Vaibhav Industrial Estate  
9 Maninagar Mavadi Plot  
Rajkot, GJ 360004  
India  
(91) 281-365365  
Fax: (91) 281-368368  
[neco@satsam.net.in](mailto:neco@satsam.net.in)  
[www.pLn.tac.com/niranjan](http://www.pLn.tac.com/niranjan)

Nissei Corporation of America  
8227-G Arrowridge Blvd.  
Charlotte, NC 28273  
(704) 527-9876  
Fax: (704) 527-9877  
[nisseicl@aol.com](mailto:nisseicl@aol.com)  
[www.gear-net.co.jp/nissei](http://www.gear-net.co.jp/nissei)



Nixon Gear Inc.  
1750 Milton Ave.  
Syracuse, NY 13209  
(315) 488-0100  
Fax: (315) 488-0196  
[sambaine@gearmotions.com](mailto:sambaine@gearmotions.com)  
[www.gearmotions.com](http://www.gearmotions.com)



Nor Elektronik Ltd.  
30 Agustos Cad. 11  
K/maltepe  
81540 Istanbul  
Turkey  
++(90) 216-3706811  
Fax: ++(90) 216-3707067  
[norel@turk.net](mailto:norel@turk.net)  
[www.nor-elektronik.com](http://www.nor-elektronik.com)



Nordex, Inc.  
50 Newtown Rd.  
Danbury, CT 06810  
(800) 243-0986  
Fax: (203) 790-8992  
[info@nordex-inc.com](mailto:info@nordex-inc.com)  
[www.nordex-inc.com](http://www.nordex-inc.com)

North Shore Gear & Tool Corp.  
752 Park Ave.  
Huntington, NY 11743  
(631) 423-5873  
Fax: (631) 423-5874  
[snwking@prodigy.net](mailto:snwking@prodigy.net)

Northern Tool & Gear Co. Ltd.  
John St. West  
Arbroath DD11 1RT  
Scotland, United Kingdom  
(44) 1241872626  
Fax: (44) 1241873636  
[northernoolandgear@btinternet.com](mailto:northernoolandgear@btinternet.com)  
[www.btinternet.com/~northernoolandgear/](http://www.btinternet.com/~northernoolandgear/)

Nuttall Gear LLC  
2221 Niagara Falls Blvd.  
P.O. Box 1032  
Niagara Falls, NY 14302  
(716) 731-5180  
Fax: (716) 731-9329  
[nuttall@nuttallgear.com](mailto:nuttall@nuttallgear.com)  
[www.nuttallgear.com](http://www.nuttallgear.com)

**O**

O'Brien Gear Company  
2396 Skokie Valley Rd.  
Highland Park, IL 60035-1735  
(847) 433-3580  
Fax: (847) 433-7825  
[nam@obriengear.com](mailto:nam@obriengear.com)

Ohio Broach & Machine Co.  
35264 Topps Industrial Park  
Willoughby, OH 44094  
(440) 946-1040  
Fax: (440) 946-0725  
[www.ohiobroach.com](http://www.ohiobroach.com)

Oliver Gear, Inc.  
1120 Niagara St.  
Buffalo, NY 14213  
(716) 885-1080  
Fax: (716) 885-1145  
[mikebarr@olivergear.com](mailto:mikebarr@olivergear.com)  
[www.olivergear.com](http://www.olivergear.com)



Orlandi Gear  
6566 Sterling Dr.  
Sterling Heights, MI 48312  
(810) 264-6700  
Fax: (810) 264-3595  
[sales@orlandigear.com](mailto:sales@orlandigear.com)  
[www.orlandigear.com](http://www.orlandigear.com)



Osaka Chain & Machinery, Ltd.  
6-17, Kitahama 2-Chome  
Chuo-Ku, Osaka 541-0041  
Japan  
(81) 6-6222-2083  
Fax: (81) 6-6222-5716  
[osaka@seiso.co.jp](mailto:osaka@seiso.co.jp)

Overton Gear & Tool Corp.  
530 Westgate Dr.  
Addison, IL 60101  
(630) 543-9570  
Fax: (630) 543-7440  
[sales@overtongear.com](mailto:sales@overtongear.com)  
[www.overtongear.com](http://www.overtongear.com)



Peerless-Winsmith, Inc.  
172 Eaton St.  
Springville, NY 14141  
(716) 592-9310  
Fax: (716) 592-9546





## COMPANY INDEX

winsmith@winsmith.com  
www.winsmith.com

Penn Machine Company  
106 Station St.  
Johnstown, PA 15905  
(814) 288-1547  
Fax: (814) 288-2260  
sales@pennmach.com  
www.pennmach.com

Pennsylvania Gear Corporation  
One Cabot Blvd. East  
Langhorne, PA 19047  
(215) 945-6000  
Fax: (215) 945-2052  
penngear@voicenet.com

Performance Gear Systems Inc.  
6751 S. Sayre Ave.  
Bedford Park, IL 60638  
(708) 728 6988  
Fax: (708) 728 6989  
info@performance-gear.com  
www.performance-gear.com

Perry Technology Corporation  
29 Industrial Park Rd.  
New Hartford, CT 06057  
(860) 738-2525  
Fax: (860) 738-2455  
sales@perrygear.com  
www.perrygear.com

PH Precision Products  
340 Commerce Way  
Pembroke, NH 03275  
(603) 228-3321  
Fax: (603) 228-3495  
info@phprecision.com  
www.phprecision.com

Philadelphia Gear  
181 S. Gulph Rd.  
King of Prussia, PA, 19406  
(610) 265-3000  
Fax: (610) 265-5637  
general@philagear.com  
www.philagear.com

Phillips-Moldex Company  
161 Park Rd.  
Putnam, CT 06260  
(860) 928-0401  
Fax: (860) 928-6613

PIC Design  
86 Benson Rd.  
P.O. Box 1004  
Middlebury, CT 06762  
(203) 758-8272  
Fax: (203) 758-8271  
info@pic-design.com  
www.pic-design.com

Poly Hi Solidur  
18179 S.W. Boones Ferry Rd.  
Portland, OR 97224  
(503) 620-9314  
Fax: (503) 620-9316  
59brocon@menasha.com  
http://polyhisolidur.com

Power Transmission Services Inc.  
501 Industrial Dr.  
Middletown, DE 19709  
(888) 295-2029  
Fax: (302) 378-7925  
pts1290@aol.com

Prager, Inc.  
P.O. Box 61670  
New Orleans, LA 70161-1670  
(504) 524-2363  
Fax: (504) 593-9920  
prager-custservice@worldnet.att.net

Precipart Corp.  
90 Finn Ct.  
Farmingdale, NY 11735  
(631) 694-3100  
Fax: (631) 694-4016  
sales@precipart.com  
www.precipart.com

Precision Gear Co.  
1900 Midway Dr.  
Twinsburg, OH 44087  
(330) 487-0888  
Fax: (330) 487-0618  
sales@precisiongear.net  
www.precisiongear.net

Precision Gear Inc.  
112-07 14th Ave.

College Point, NY 11356-1407  
(718) 321-7200  
Fax: (718) 321-7001  
precisiongearinc.com

Precision Gears, Inc.  
N13 W24705 Bluemound Rd.  
Pewaukee, WI 53072  
(262) 542-4261  
Fax: (262) 542-1592  
www.precisiongears.com

Presrite Corporation  
3665 E. 78th St.  
Cleveland, OH 44105  
(216) 441-5990  
Fax: (216) 441-2644  
info@presrite.com  
www.presrite.com

Process Gear Company/Gears for Industry  
3860 N. River Rd.  
Schiller Park, IL 60176  
(847) 671-1631  
Fax: (847) 671-6840  
www.processind.thomasregister.com

Productgear  
1900 W. 34 St.  
Chicago, IL 60608  
(773) 847-4505  
Fax: (773) 847-6348  
tomj@productgear.com  
www.productgear.com

Pro-Gear Co., Inc.  
23 Dick Rd.  
Depew, NY 14043  
(716) 684-3811  
Fax: (716) 684-7717  
progearinc@aol.com

Prophet Gear  
Route 78 North  
P.O. Box 3  
Prophetstown, IL 61277  
(815) 537-2002  
Fax: (815) 537-2228

The Purdy Corporation  
586 Hilliard St.  
P.O. Box 1898  
Manchester, CT 06045-1898  
(860) 649-0000  
Fax: (860) 645-6293  
sales@purdytransmissions.com  
www.purdytransmissions.com

Putnam Precision Molding, Inc.  
11 Danco Rd.  
Putnam, CT 06260  
(860) 928-7911  
Fax: (860) 928-2229  
ccampbell@putnamprecisionmolding.com  
www.putnamprecisionmolding.com

Quality Gear  
7408 S.E. Johnson Creek Blvd.  
Portland, OR 97206  
(503) 774-3083  
Fax: (503) 774-8529  
mfggears@aol.com

Quality Gear Mfg.  
801 Corporate Circle  
Toms River, NJ 08755  
(732) 341-0036  
Fax: (732) 341-2122  
rob.qg@qualitygearmfg.com  
www.qualitygearmfg.com

Quality Transmission Components  
2101 Jericho Tpke.  
P.O. Box 5416  
New Hyde Park, NY 11042-5416  
(516) 437-6700  
Fax: (516) 326-8827 or (800) 737-7436  
support@qtcgears.com  
www.qtcgears.com

Radina-M  
Trakia 332-2-8-22  
4023 Plovdiv  
Bulgaria  
(359) 32-830001  
geardesign@hotmail.com

Randy's Ring & Pinion  
11630 Airport Rd. # 300  
Everett, WA 98204  
(425) 347-1199  
Fax: (425) 347-1440

## SPIRAL BEVEL GEARS (Transmissions)



Spiral & Straight Bevel Gear Manufacturing.  
Commercial to aircraft quality gearing.  
Spur, helical, splined shafts, internal & external,  
shaved & ground gears. Spiral bevel grinding.  
Midwest Transmissions & Reducers.  
ISO compliant.

MIDWEST GEAR  
& TOOL, INC.  
12024 E. Nine Mile Road  
Warren, MI 48089



CONTACT:  
CRAIG D. ROSS  
BRAD MARQUARDT  
(810) 754-8923  
FAX (810) 754-8928

CIRCLE 203

Unmatched  
Capabilities,\*  
Unmatched  
Solutions...  
Get to Know Bourn & Koch!

- \* OEM Gear Hobbers
- \* OEM Gear Grinders
- \* OEM Hob Checkers
- \* Gear Manufacture
- \* Gear Seminars
- \* Gear Software
- \* Remanufacture/Retrofit/Recondition/Repair of Your Barber-Colman Hobber/Shaper/Hob Sharpener/Hob Chucker
- \* Parts/Field Service for Barber-Colman, Ferguson and Bourn & Koch Products

**BOURN  
& KOCH**  
MACHINE TOOL CO.

2500 Kishwaukee St. • Rockford, IL 61104  
Phone: 815/965-4013 • Fax: 815/965-0019  
E-mail: bournkoch@worldnet.att.net  
Internet: www.bourn-koch.com

CIRCLE 147



# COMPANY INDEX

ringandpinion@ring-pinion.com  
www.ring-pinion.com

Rapid Gear  
1596 Strasburg Rd.  
Kitchener, Ontario N2R 1E9  
Canada  
(519) 748-4828  
Fax: (519) 748-5528  
rapid@rapidgear.com  
www.rapidgear.com

Rawling Gear Inc.  
890 Hartford Tpke.  
Shrewsbury, MA 01545  
(508) 845-6532  
Fax: (508) 845-6534  
www.gearmotions.com

Reef Gear Mfg.  
50903 Russell Schmidt Blvd.  
Chesterfield, MI 48051-2458  
(810) 949-2520  
Fax: (810) 949-3481  
reefgears@aol.com  
www.reefgear.com

Reliance Gear Corp.  
205 Factory Rd.  
Addison, IL 60101  
(630) 543-6640  
Fax: (630) 543-0520  
www.reliancegear.com

RjLink International  
374 Publishers Dr.  
P.O. Box 6939  
Rockford, IL 61125  
(815) 874-8110  
Fax: (815) 874-8833  
wcarlson@rjlink.com  
www.rjlink.com

Roe Machine  
1808 Ogden St.  
Omaha, NE 68110  
(402) 453-6777  
Fax: (402) 453-8481

Ronson Gears Pty. Ltd.  
18 Teton Ct.  
Highett, Victoria 3190  
Australia  
++ (61) 3-9555-9822  
Fax: ++ (61) 3-9555-7480

Rush Gears Inc.  
550 Virginia Dr.  
Fl. Washington, PA 19034  
(215) 542-9000  
Fax: (215) 542-1428  
sales@rushgears.com  
www.rushgears.com

## S

Schafer Gear Works, Inc.  
4701 Nintz Pkwy.  
South Bend, IN 46628  
(219) 234-4116  
Fax: (219) 234-4115  
bdoshi@schafergear.com  
www.schafergear.com

Schwartz Precision Gear Co.  
24649 Mound Rd.  
Warren, MI 48091  
(810) 754-4600  
Fax: (810) 754-4603  
spgear@ameritech.net

Seitz Corporation  
212 Industrial Ln.  
P.O. BOX 1398  
Torrington, CT 06790  
(800) 261-2011  
Fax: (860) 496-1949  
brians@seitzcorp.com  
www.seitzcorp.com

Selector Spline Products Inc.  
7665 19 Mile Rd.  
Sterling Heights, MI 48314  
(810) 254-4020  
Fax: (810) 254-7430  
sspi@tit.com

SEW-Componenta Pte Ltd.  
9 Tuas Drive 2  
Jurong 638644 Singapore  
(65) 8621701  
Fax: (65) 8638112  
asiapacific@sew-componenta.com  
www.sew-componenta.com

Shanthi Gears  
304-A Trichy Rd., Singanallur  
Coimbatore, Tamil Nadu 641 005  
India  
++(91) 422-574241  
Fax: ++(91) 422-574244 & 574245  
sglcb@md2.vsnl.net.in  
www.shanthigears.com

Shin Han Precision & Industry  
#32-68 Dang San-Dong 4Ka  
Young Dung Po-Ku  
Seoul 150-044  
Korea  
++(82) 2-677-5490/5445  
Fax: ++(82) 2-2633-6893  
shinhanp@kosis.net  
www.kita.or.kr/catalog/shinhan

SIPCO  
12610 Galveston Rd.  
Webster, TX 77598  
(281) 480-8711  
Fax: (281) 480-8656  
sipco@sipco-tech.com  
www.sipco-tech.com

SPM  
9300 52nd Ave. North  
Minneapolis, MN 55428  
(612) 416-2004  
Fax: (612) 416-2005  
creese@dynacast.com

Springer Company  
315 E. Grandview Ave.  
P.O. Box 26  
Zelienople, PA 16063  
(412) 452-7737  
Fax: (412) 452-0685  
springco@sgi.net

Stahl Gear & Machine Co.  
3901 Hamilton Ave.  
Cleveland, OH 44114  
(216) 431-2820  
Fax: (216) 431-1666  
stahlgear@aol.com

STD Precision Gear & Instrument, Inc.  
318 Manley St., Unit #5  
W. Bridgewater, MA 02379  
(508) 580-0035  
Fax: (508) 580-0071  
stdgear@aol.com  
www.stdgear.com

Sterling Instrument  
2101 Jericho Tpke.  
New Hyde Park, NY 11040  
(516) 328-3300  
Fax: (516) 326-8827  
www.sdp-si.com

Stock Drive Products  
—see Sterling Instrument

Stock Gears Inc.  
1401 Redecker Rd.  
Des Plaines, IL 60016  
(847) 827-6100  
Fax: (847) 827-6103  
stockgearsinc@worldnet.att.net

Suda International Gear Works  
P.O. Box 4  
Pittsford, NY 14534  
Fax: 716-385-8537  
lgkrunly@worldnet.att.net  
www.sudagear.com

Suhner Manufacturing Inc.  
P.O. Box 1234  
100 Anderson Dr.  
Rome, GA 30162-1234  
(706) 235-8046  
Fax: (706) 235-8045  
info@suhnerusa.com  
www.suhnerusa.com

Sumitomo Machinery Corp. of America  
4200 Holland Blvd.  
Chesapeake, VA 23323  
(757) 485-3355  
Fax: (757) 485-3075  
smcamkig@series2000.com  
www.smcyco.com

Supreme Gear Company  
19024 Florida  
Roseville, MI 48066  
(810) 775-6325  
Fax: (810) 775-1227  
rdiez@supremegear.com  
www.supremegear.com

Syntec Custom Injection Molders  
7100 Junction Rd.  
Pavilion, NY 14525  
(716) 768-2513  
Fax: (716) 768-7138  
sweinstein@syntecmolders.com  
www.syntecmolders.com

## T

Ta-Tung Gear Co.  
19532 Windrose Dr.  
Rowland Heights, CA 91748  
(909) 595-5502  
Fax: (909) 595-5282  
ttginc@vividnet.com  
www.ttgear.com

TIFCO Gage & Gear  
29905 Anthony Dr.  
Wixom, MI 48393  
(248) 624-7900  
Fax: (248) 624-1260  
sales@tifcogagegear.com

Titanium Engineering & Mfg.  
1509 Fairfield Ave.  
Lima, OH 45805  
(419) 221-2160  
Fax: (419) 221-2160  
abr3877525@aol.com

Transmission Engineering Co. Inc.  
1851 N. Penn Rd.  
Hatfield, PA 19440  
(215) 822-6737  
Fax: (215) 822-5608  
ptsales@transeng.com  
www.transeng.com

Trogetec Inc.  
605 E. Washington Ave.  
Riverton, WY 82501  
(307) 856-0579  
Fax: (307) 856-0579  
info@trogetec.com  
www.trogetec.com

Tsubakimoto Chain Co.  
17-96, Tsurumi 4-Chome, Tsurumi-Ku  
Osaka, 538-8686  
Japan  
++(81) 6-6912-9174  
Fax: ++(81) 6-6913-5315  
bill@tsubakimoto.co.jp  
www.tsubakimoto.co.jp/english

## U

UFE Incorporated  
1850 S. Greeley St.  
P.O. Box 7  
Stillwater, MN 55082-0007  
(651) 351-4100  
Fax: (651) 351-4101  
www.ufeinc.com

Unicor, Inc.  
13690 172nd Ave.  
Grand Haven, MI 49417  
(616) 842-9631  
Fax: (616) 842-8018  
sales@unicor.net  
www.unicor.net

Union Gear & Sprocket Corp.  
111 Penn St.  
Quincy, MA 02269  
(800) 535-3321  
Fax: (617) 479-9211  
uniongear@erols.com

Unique Power Products, Inc.  
P.O. Box 439  
7501 Miller Dr.  
Frederick, CO 80530  
(303) 684-0629  
Fax: (303) 684-0579  
powerproducts@uqm.com  
www.powerproducts.uqm.com

## V

Valley Gear & Machine Inc.  
514 Chickory St.  
Bad Axe, MI 48413  
(517) 269-8177  
Fax: (517) 269-7686  
vgear@avcl.net  
www.valley-gear.com

Van Zeeland Mfg., Inc.  
103 W. North Ave.  
P.O. Box 303

Little Chute, WI 54140  
(920) 788-6326  
Fax: (920) 788-6164  
info@vzmsprockets.com  
www.vzmsprockets.com

Von Ruden Mfg. Inc.  
1008 First St. North East  
Buffalo, MN 55313  
(763) 682-3122  
Fax: (763) 682-3954  
brandon@vonruden.com  
www.vonruden.com

Vorpe Microgears Switzerland  
Tradelink Suite 800  
120 Albany St. Plaza  
New Brunswick, NJ 08901  
(732) 514-0241  
Fax: (732) 514-1041  
vorpesa@mail.vtx.ch

## W

Weatherford ALS  
11500 W. Hwy 80 East  
Odessa, TX 79765  
(915) 563-0165  
Fax: (915) 563-0934  
doug.labombard@weatherford.com  
www.weatherford.com

West Industries, Inc.  
1700 Livingstone Rd.  
Hudson, WI 54016-9365  
(715) 386-5867  
Fax: (715) 386-6473  
shellyk@westindustries.com  
www.westindustries.com

Windsor Gear & Drive Inc.  
204 E. Pike Creek Rd.  
P.O. Box 100  
Emeryville, ON NOR 1C0  
Canada  
(519) 979-9400  
Fax: (519) 979-9399  
edquette@windsorgear.com  
www.windsorgear.com

Winzeler Gear  
7355 W. Wilson Ave.  
Chicago, IL 60656  
(708) 867-7971  
Fax: (708) 867-7974  
jwinzeler@winzelergear.com  
www.winzelergear.com

Wohlert Corporation  
P.O. Box 20217  
508 E. Grand River Ave.  
Lansing, MI, 48906  
(517) 485-3750  
Fax: (517) 485-0501  
TNowicki@Wohlert.com  
www.wohlert.com

## X

Xtek, Inc.  
11451 Reading Rd.  
Cincinnati, OH 45241  
(513) 733-7842  
Fax: (513) 733-7820  
ted.dageford@stek.com  
www.stek.com

Xtek Mining Services  
1710 W. Broadway St.  
Tempe, AZ 85282  
(480) 968-6141  
Fax: (480) 894-2644  
zmssteve@aol.com

## Z

Zero-Max, Inc.  
13200 Sixth Ave. North  
Minneapolis, MN 55441  
(612) 546-4300  
Fax: (612) 546-8260  
kwellts@zero-max.com  
www.zero-max.com

Zhuhai Intercontinental Palleyes Ltd.  
43-101A Bailian Xincun Jida  
Zhuhai, Guangdong 519015  
China  
++(86) 756-3366825  
Fax: ++(86) 756-3357936  
zhcicui@pub.zhuhai.gd.cn  
www.zic.net



# New manufacturing capacity ready!

## ATA



**ATA Gears Ltd. has gained worldwide approval as a manufacturer of high quality spiral bevel gears – with the help of professional experience over 60 years and modern technology.**

Our main product is spiral bevel gears up to 2500 mm ( 100 in) diameter. Our experience in handling highly classified materials, our universal gear cutting systems as well as our own heat treatment spotlight as a gear producer for demanding customers such as the off-shore and mining , as well as the machine tool- and heavy vehicle industry. ATA's gear finishing methods, lapping, hard cutting and grinding, enable accuracy classes up to DIN Q=4 (AGMA Q=14).

ATA Gears, Inc.  
19885 Detroit Road  
Rocky River, Ohio 44116  
Tele/Fax: 440-356-0289

In addition to spiral bevel gears ATA also manufactures custom tailored complete gear units for demanding applications. The ATA product development work is remarkably represented by propeller-turbine operated small electric power plants. "Turn-key", service-free hydroelectric power plants produce, with falls of 2-20 meters, power capacity of 20-2500 kW. Hydro turbines demonstrate in a magnificent way the scope of application for ATA's product development.

### ATA GEARS LTD

Mailing address: P.O. Box 120, FIN-33101 Tampere, FINLAND  
Tel +358 3 2870 111, Fax +358 3 2870 249

e-mail: [postmaster@ata-gears.fi](mailto:postmaster@ata-gears.fi) • internet: [www.ata-gears.fi](http://www.ata-gears.fi)



# MANUFACTURING

A vital  
of life™



## Gears make the world go around

***BUT YOU DON'T HAVE TO GO AROUND THE WORLD TO FIND THE COMPANIES THAT MAKE THE MACHINES THAT MAKE THE GEARS. → JUST COME TO THE GEAR GENERATION PAVILION AT IMTS 2000.***

Here they are, the world's top companies in this highly specialized field. → Come see fascinating demonstrations of gear hobbers, shapers, cutters, shavers, broaching, grinding and measuring. → This is the only time until 2002 that you can see them all side by side in one place in America. → And you'll meet and talk to the wizards who create these marvelous machines.

**Gear up for a lesson in productivity!**

*There are 10 pavilions in all . . . and lots more info at [imtsnet.org](http://imtsnet.org)*



Abrasive  
Machining/  
Sawing/  
Finishing



Controls &  
CAD-CAM



EDM



Gear  
Generation



Lasers  
and Laser  
Systems



Machine  
Components/  
Cleaning/  
Environmental



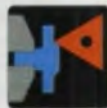
Metal  
Cutting



Metal Forming  
& Fabricating



Quality  
Assurance



Tooling &  
Workholding  
Systems



The Vital Manufacturing Show

# IMTS

Chicago, September 6-13, 2000

## International Manufacturing Technology Show

7901 Westpark Drive, McLean, VA 22102-4206 USA • Phone: 703-893-2900 or 800-322-4687 Fax: 703-893-1151

**DISCOVER THE NEW  
IMTSNET.ORG**

Tech data, statistics, industry and marketing news, timely features and articles, complete IMTS and hotel info, 24/7 virtual show rooms. Always something new.

**IT'S A  
HIT!!!**



Welcome to our Product News page. Here we feature new products of interest to the gear and gear products markets. To get more information on these items, please circle the Reader Service Number shown.



### New UltraTrue Planetary Gearhead

Thomson Micron, LLC has expanded its line of ultra-precision planetary gearheads with the UltraTrue Size 220 Planetary Gearhead, which offers a torque capacity of over 4,000 ft-lbs.—the highest torque capacity in its size. The output housing and the helical internal gear are machined from a single piece of steel for high strength and torsional rigidity. Helical crowned planet gears make for the smoothest, whisper-quiet operation available in a planetary gearhead.

This new gearhead features a maximum backlash of 4 arc-minutes, ratios from 4:1 through 100:1, and a 75 mm output shaft for maximum torsional stiffness. It is ideal for applications such as coil winding, pipe bending, packaging, machine tools, overhead gantry systems, and injection molding machines. For more information, contact Thomson Micron at (516) 883-8000 or log onto [www.thomsonindustries.com](http://www.thomsonindustries.com).

Circle 300

### Full 3D Transmission Analysis-Led Design System

Romax Technology announces the immediate availability of RomaxDesigner R1.8. This latest release of Romax Designer extends the modeling tools to provide a complete powertrain capability from gearbox input to axle driveshafts, including non-parallel shaft arrangements. Based a powerful, object-oriented “analyze as you design” approach, users can now design gearboxes and axle systems that incorporate perpendicular shaft arrangements.

RomaxDesigner’s highly productive environment means that as the user lays out the design using components, the analysis model is automatically assembled behind the scenes. The user defines the component connectivity from which analysis boundary conditions are derived. Consequently, static, dynamic and life analysis of shafts, bearings and

gears is available as soon as the design is defined. Analysis of forces and deflections is provided by a hyperstatic non-linear solution algorithm that completes stress and life analysis of complex systems subject to realistic life cycle loading in a few minutes.

For more information, contact Romax Technology Ltd. at (+44) 1636-61-4000.

Circle 301

**NEVER AGAIN!**



### Dry Hobbing From Mitsubishi: Twice The Productivity, Three Times The Tool Life, And A Cleaner, Healthier Shop.

Now you can cut gears in a way that’s totally clean and dry, with great precision, in about half the time, meaning a big reduction in cost per manufactured part — and with three times the tool life. It’s dry hobbing from Mitsubishi. You’ve got to see it.



**MITSUBISHI MACHINE TOOLS**

MHI MACHINE TOOL USA, INC.  
1250 Greenbrier Drive, Suite B • Addison, IL 60101  
ph: 630-693-4700 • fax: 630-693-4710  
[www.mhi-mmt.com](http://www.mhi-mmt.com)



CIRCLE 198



### New Cylindrical Grinder from Mitsubishi

The new R230 cylindrical grinder from Mitsubishi combines an innovative PC-based control with manual hand-wheel operation for machining short runs of different workpieces. This allows machinists with little CNC experience to be introduced to computerized controls, and makes the R230 a low-cost alternative to full CNC grinding.

No NC knowledge is required to operate the R230. Its easy-to-use PC-based control features an innovative teaching/playback function. This replaces the complex programming and tedious debugging necessary for CNC operations. By selecting the teaching mode, the R230 memorizes the hand-wheel movements made by the operator when creating the grinding sequence for the first workpiece in a lot. The sequence

is completely documented by the R230's control and can be reviewed by the operator in order to make any edits. The grinding program is stored in the control's memory and can be accessed at any time. To grind the remaining workpieces in a lot, the playback mode is selected and the R230 automatically repeats the grinding sequence exactly as it was manually run the first time. There's no need for further hand-wheel operation. The PC-based control stores up to 30 grinding applications and allows 10 grinding steps per application.

For more information on the R230, contact MHI Machine Tool U.S.A. at (630) 860-4222 or log onto [www.mhi-mmt.com](http://www.mhi-mmt.com).

Circle 302



Est. 1946

## THE PURDY CORPORATION

ISO 9002 CERTIFIED

### Aerospace Manufacturing Technologies For The 21st Century



AH-64  
Longbow Apache  
Attack Helicopter  
Main Rotor  
Transmission

586 Hilliard Street, P.O. Box 1898, Manchester, CT 06045-1898 U.S.A.  
Telephone: 860 649-0000 • Fax: 860 645-6293  
Home Page: <http://www.purdytransmissions.com>  
E-Mail: [sales@purdytransmissions.com](mailto:sales@purdytransmissions.com)

© 1998 THE PURDY CORPORATION

CIRCLE 201

### New Heavy Duty Synthetic Coolant

Rustlick PowerChip 2000, manufactured by ITW Fluid Products Group, is a new biostable, heavy-duty synthetic coolant for machining, grinding and sawing. PowerChip 2000 provides excellent lubricity, rust protection and low foaming. Its superior way-lube rejection leads to cleaner coolant and longer sump life. In addition, PowerChip 2000 has exceptional biostability, providing long-term sump life with proper maintenance.

PowerChip 2000 is a transparent, blue solution that allows easy viewing of the workpiece. Its non-chlorinated E.P. additive provides extended tool life. Safe for most metals, except magnesium, it works well with titanium, Inconel and stainless steel. PowerChip 2000 is also suitable for hard-to-machine aluminum and other alloys. It can be used in hard water applications and comes in 5-gallon pails and 55-gallon drums. For more information, contact the ITW Fluid Products Group at (800) 452-5823.

Circle 303

#### Tell Us What You Think . . .

If you found this column of interest and/or useful, please **circle 268**.

If you did not care for this column, **circle 269**.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).



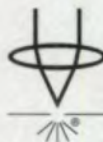
# LASER STRENGTH LOW DISTORTION

**HIGH PERFORMANCE  
LASER SOLUTIONS  
FOR GEAR WELDING  
& HEAT TREATING**

Visit: [www.lasermachining.com](http://www.lasermachining.com)

**OR CALL 800-77-LASER**

For fast response to your specific needs, e-mail:  
[dplourde@lasermachining.com](mailto:dplourde@lasermachining.com) or [lkotval@lasermachining.com](mailto:lkotval@lasermachining.com)



**LASER MACHINING, INC.**

*Providing Laser Solutions for Industry*

CIRCLE 131

## **Unite-A-Matic™** **TRUE DIMENSION GEAR INSPECTION**



Provides actual over ball/pin measurement of any helical or spur gear or spline without the need of costly setting masters.

Provides vital S.P.C. information.

**CAPACITY:**

**9" O.D.**

**8" I.D.**

Gage Division

**United Tool Supply**

851 OHIO PIKE • CINCINNATI, OHIO 45245 • (513) 752-6000 • FAX (513) 752-5599

CIRCLE 137





## THE NEW MEGA

Profile-generating gear grinder from HÖFLER. There is no easier, safer and more productive way to grind large gears. HÖFLER offers 40 years of experience in the manufacture of gear grinders for gears from 1 to 180 inches.

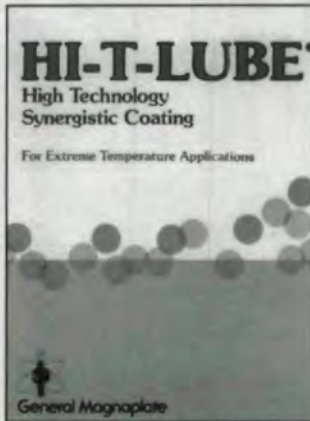
For more information contact  
**HÖFLER/ Germany**  
 Fax: 011(49) 7243/599-165  
**HÖFLER CORP./ USA**  
 Fax: 908-9966-922  
 CIRCLE READER SERVICE #169



## INDUCTION FIXTURES

The LR-PAK data sheet describes induction lift rotate fixtures useful for heat treating parts such as transmission O.D. races, I.D. cams, hubs, spindles, C.V. joints and gears. LR-PAKs are completely assembled and interconnected.

**Ajax Magnethermic Corp.**  
 1745 Overland Avenue  
 Warren, OH 44482  
 800-547-1527  
 Fax: 330-372-8608  
 CIRCLE READER SERVICE #162



## WORLD'S SLIPPERIEST SOLID LUBRICANT PREVENTS WEAR

HI-T-LUBE® dry-film lubricant solves wear, galling and fretting problems for gears, bearings and other metal parts, even at high and low operating temperatures. Works under high compression loads, in a vacuum and in high radiation environments.

**General Magnaplate Corp.**  
 (800) 852-3301  
<http://www.magnaplate.com>  
 CIRCLE READER SERVICE #164



## AUSTEMPERING IMPROVES MATERIAL TOUGHNESS

Our 8-page brochure is an information-packed guide to the Austempering process, a high performance heat treatment for ductile iron, gray iron, and steel for improved toughness, wear resistance, and fatigue strength. Learn how to boost product performance, and reduce costs.

Call **Applied Process, Inc.**,  
 734-464-2030 or visit  
<http://www.appliedprocess.com>  
 CIRCLE READER SERVICE #163



Gleason Pfauter Hurth Cutting Tools



## GLEASON PFAUTER HURTH CUTTING TOOLS CORPORATION

A full color brochure showing the product capabilities of our Loves Park, Illinois facility. We manufacture high-speed steel and carbide hobs, shaper cutters, form cutters, CBN wheels and thin film coatings. Heat-treat, resharpening and reconditioning services are available.

**Gleason Pfauter Hurth Cutting Tools Corporation**  
 Telephone 815-877-8900  
 E-mail: [sales@gphct.com](mailto:sales@gphct.com)  
 CIRCLE READER SERVICE #167



## METRIC GEARS

NEW 456-page catalog features technical specs for over 3400 standardized metric gear components: spur, helical and internal gears, straight and helical racks, straight and spiral bevel gears, worm and worm gears, and more in modules 0.5-10.

**Quality Transmission Components**  
 2101 Jericho Tpk, Box 5416  
 New Hyde Park, NY 11042  
 PHONE: 516-437-6700  
 FAX: 800-737-7436  
 WEB: <http://www.qtcgears.com>  
 CIRCLE READER SERVICE #173



## HOLROYD MACHINES

Holroyd is the world leader in the production of the most comprehensive range of machines to produce profiles on screw compressor rotors for every application, ensuring production of first class quality components at competitive prices.

Phone: (44) 1706-526590  
 Fax: (44) 1706-353350  
 Email: [info@holroyd.com](mailto:info@holroyd.com)  
 Web site: <http://www.holroyd.com>

CIRCLE READER SERVICE #170



# LITERATURE MART



## GLEASON PFAUTER HURTH INTRODUCES THE GP SERIES:

a new line of gear hobs, shapers and grinders that share a "common platform" and use standard modules to greatly simplify the traditional processes of machine design, assembly and maintenance. They're designed to take advantage of the latest tool technologies available—wet or dry. Call us at (815) 877-8900 to request this brochure.

CIRCLE READER SERVICE #166



## INDUSTRIAL GEAR MANUFACTURING

Literature available from The Cincinnati Gear Company provides information covering its facilities and capabilities in industrial gear manufacturing, including hobbing and cutting, grinding, turning, boring, milling and inspection. The brochure includes production facility photos, product specifications, and application information. Data is also offered covering the company's testing capabilities and engineering services.

CIRCLE READER SERVICE #193



## METROLOGY SYSTEMS

M&M metrology systems are designed for universal application and ease of operation-making them ideal for a wide range of inspection and process control tasks. This brochure describes how they employ **generative motion** via **linear interpolation** for lead and involute measurement. M&M software can be used on remote or networked PC's for SPC study or data entry. For a free copy, call 937-859-8273 or fax 937-859-4452.

CIRCLE READER SERVICE #171



## STAR PRECISION HOBBS

Star Cutter Co. manufactures engineered HHS and carbide hobs from Class AAA through Class D We also apply, in our own facilities, TiN, Ti(C,N), (Ti,AL)N and other thin film coatings. We also offer resharp-ening, recoating and, depending on location, pick-up and delivery. Star Cutter Co.

P.O. Box 376  
Farmington, MI 48332-0376  
Phone: 248/474-8200  
Fax: 248/474-9518  
[www.starcutter.com](http://www.starcutter.com)

CIRCLE READER SERVICE #174



## Designing, manufacturing or producing wormgears?

Holroyd is the complete helical technology center offering a unique range of machines, products and services:

- "Smart" CNC THREAD GRINDING CENTERS
- The most accurate and flexible system in the world
- Unique on machine co-ordinate measurement probing
- High speed worm milling systems - the fastest available today
- Advanced wormgear and screw profile measurement machines
- Duplex type 'zero' backlash wormgears
- AGMA Standard 14
- Flank Transmission Testing Facility
- Contact, Torque & Efficiency Reports
- 1 1/2" - 41" center distances
- ISO 9001 Approved
- Sales & Service Facilities based in USA

Contact Holroyd today and discover how we can introduce excellence into your product

Head Office:  
Harbour Lane North,  
Milnrow, Rochdale  
OL16 3LQ England  
Tel: +44 (0)1706 526590  
Fax: +44 (0)1706 353350  
Web: [www.holroyd.com](http://www.holroyd.com)  
Email: [info@holroyd.com](mailto:info@holroyd.com)



**RENOLD**  
Precision Technologies

CIRCLE 130



# CLASSIFIEDS

## SOFTWARE

### GRAPHICAL GEAR DESIGN

- Generated Gears
- Tools and Tool Paths
- Non-Generated Gears
- Involute Splines, Racks
- Inspection Calculations
- Animated Meshing
- Form Calculations
- .DXF File Output



**GearShop for Windows™**

*Because you asked for it!*

**800-437-2368**

CIRCLE 192

## BROACHING

### PRODUCTION BROACHING

- Vertical, Horizontal, Surface, Pot and Chain Broaching Machines
- Surface and Internal Broaching
- 45 Production Machines
- SPC Inspection Documentation
- Complex Parts to Tight Tolerances
- ISO 9001 Certified

Think of us as an extension of your production department when your workload is heavy, or as a cost-efficient source for your outside broaching needs at any time.



**OHIO BROACH & MACHINE COMPANY**  
(440) 946-1040 • Fax: (440) 946-0725  
[www.ohiobroach.com](http://www.ohiobroach.com)

CIRCLE 200

## HELP WANTED

### WE'RE HIRING

**Gear Machine Repairman** — Experienced troubleshooter for mechanical and hydraulic repairs. Knowledge of electrical systems desirable. No travel. Friendly work environment at our convenient northwest suburban Chicago location. Profit sharing, health insurance.



**Cadillac Machinery Co. Inc.**  
1401 Lunt Avenue  
Elk Grove, IL 60007  
E-mail: [sales@cadillacmachinery.com](mailto:sales@cadillacmachinery.com)  
Fax your resume to 847-437-6618.

## SERVICE

### MAAG PARTS AND SERVICE

Original **MAAG** Parts for all:

- Grinding Machines
- Shaping Machines (SH)
- Inspection Machines

Swiss Trained Service Engineers:  
Repairs to Complete Rebuilds

- Calibration
- Certification
- Evaluations

### Becker GearMeisters, Inc.

(800) 423-2537 • (631) 821-3967



Fax: (631) 821-3870  
Chicago, Illinois

CIRCLE 197

- HOB SHARPENING
- SHAVING CUTTER GRINDING

• TiN, TiCN, & TiAlN  
COATING SERVICES

- CUSTOM HEAT TREAT SERVICE

PICK UP AND DELIVERY IN MANY AREAS

**Gleason PFAUTER HURTH**  
CUTTING TOOLS CORPORATION

1351 Windsor Road, P.O. Box 2950  
Loves Park, IL 61132-2950  
Phone (815) 877-8900  
Fax (815) 877-0264

CIRCLE 152

### GEAR TOOTH GRINDING SERVICES

*Spur - Helical - Double Helical*

Capacity up to 60.5" O.D., 1 D.P., 29" Stroke. All ground gears certified up to AGMA Class 14+ on Zeiss-Hofler 1602 CMM. Inventory of grinders includes Hofler 800, Hofler 1000, Hofler 1253 Supra, Hofler 1500 and Hofler Nova CNC 1000 (Fully CNC with on-board CMM checker).

#### Kreiter Geartech

2530 Garrow St., Houston, TX 77003  
Phone: 713-237-9793 Fax: 713-237-1209  
Contact: Mr. Willie Whittington  
Visit our Website at  
[www.kreiter-geartech.com](http://www.kreiter-geartech.com)

CIRCLE 204

### HOB SHARPENING SERVICE

*Star Cutter Co.*



- THIN FILM COATINGS

West Branch Industries  
Subsidiary of Star Cutter Co.  
2083 W. M-55, West Branch, MI 48661  
1-888-Resharp • 1-888-737-4277  
Phone: (517) 345-2865 • FAX: (517) 345-5660

CIRCLE 157

### Tooth by Tooth Induction Hardening Specialists

*Spur, helical and bevel gears*

Our gear hardening equipment includes 5 NATCO submerged process machines and 5 AJAX CNC-controlled gear scanning machines. Tooth by tooth gear hardening from .5DP-10DP, up to 15 tons. Ask about our break-down service.

#### American Metal Treating Company

Cleveland, Ohio  
(216) 431-4492  
Fax: (216) 431-1508  
Email: [bruce@americanmetaltreating.com](mailto:bruce@americanmetaltreating.com)  
Web site: [www.geartechnology.com/copage/amtc.htm](http://www.geartechnology.com/copage/amtc.htm)

CIRCLE 151

### GEAR TOOTH GRINDING

- Spur • Helical
- Herringbone (with groove)
- Capacity up to 63" O.D.,  
1 D.P., 16" face

AGMA Certification Inspection  
Delivery to Meet Your Requirements

Midwest Gear Corp.  
2182 E. Aurora Rd.  
Twinsburg, OH 44087  
Phone 330-425-4419  
Fax 330-425-8600

Direct your inquiries to  
Ron Humphrey, General Manager  
[ronh@mwgear.com](mailto:ronh@mwgear.com)

CIRCLE 154



## SERVICE

### HOB SHARPENING (763) 425-5247

HSS & Carbide up to 5" Dia.  
Straight Gash,  
Sharpened & Inspected  
Per AGMA STANDARDS  
*Quick Turnaround*



RADIAL CUTTING FACE SHOWN

**KORO SHARPENING SERVICE**  
9530 - 85TH AVENUE NO.  
MAPLE GROVE, MN 55369

CIRCLE 153

## GROUND GEARS

- Precision Ground Spur, Helical and Pump Gears to AGMA Class 15
- The latest grinding technology including:
  - Reishauer RZ300E Electronic Gear Grinders
  - Gleason TAG 400 CNC High Production Gear Grinder
  - Cincinnati Milacron CNC Cylindrical Grinder
- Continuous Process Improvement Utilizing SPC and Quality Planning
- JIT Delivery using Innovative Stocking Programs

800-447-2392  
Fax: 716-874-9003  
www.niagaragear.com  
email: info@niagaragear.com



CIRCLE 155

## GEAR TOOTH GRINDING SERVICES

- Cost effective gear tooth grinding specialists
- Gear manufacturers are our only customers
- Prototype and production quantities
- Capacity to 27.5" P.D., 3.5 D. P.
- Able to match delivery to your requirements
- All service to AGMA standards with Certified Gear Inspection Equipment

### PRO-GEAR COMPANY, INC.

23 Dick Road, Depew, NY 14043  
Toll Free: 877-684-3810 • Fax: 716-684-7717  
E-mail: progearinc@aol.com

CIRCLE 156

VISIT *The Gear Industry Home Page™* to find:

- GEAR MACHINE TOOLS
- INSPECTION EQUIPMENT
- CUTTING TOOLS
- WORKHOLDING
- CUSTOM GEAR MFG. SERVICES

[www.geartechology.com](http://www.geartechology.com)

# 3 REASONS TO USE COLONIAL SPLINE RACKS



**1** Proprietary design, engineering and manufacturing.

**2** Involute splines, helical splines, tapered splines, threads.

**3** Production spline rolling supported by SPC.

If you're going by the numbers, Colonial Tool Group has all the reasons you need to have us be your spline rolling service supplier. We're a leading designer and manufacturer of high quality precision spline rolling racks, with extensive prototype capability. And if you need pre-production or production spline rolling services... we do that too!

*Call, write, FAX or E-mail us off our Web Site.*

## COLONIAL TOOL GROUP INC.

1691 Walker Road, Windsor, Ontario, Canada N8W 3P1  
519-253-2461 • FAX 519-253-5911 • [www.colonialtool.com](http://www.colonialtool.com)  
In the U.S.A. 5505 Concord Ave., Detroit, MI • 313-965-8680

CIRCLE 209



The  
Little

# STEAM ENGINE

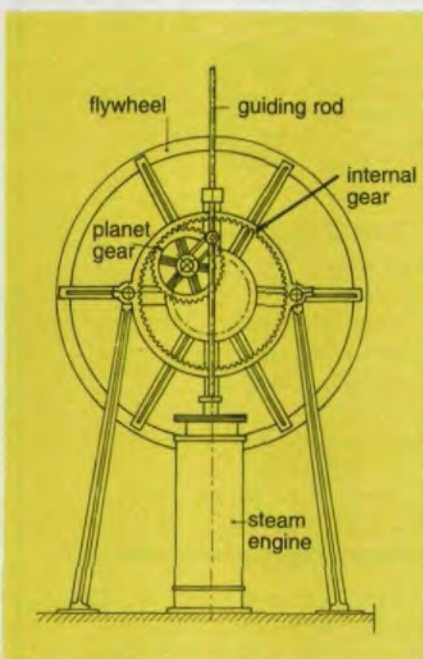
That  
Did.

J. A. Broekhuisen

*Gear Technology's* bimonthly aberration — gear trivia, humor, weirdness and oddments for the edification and amusement of our readers. Contributions are welcome.

**W**hen the steam engine became available for industrial use at the end of the eighteenth century, it was mainly used for driving plunger-pumps, such as those used in English coal mines. The steam engine's piston drove a lever, the reciprocating motion of which drove the pump plunger. Called the "Beam Machine," this mechanism needed a lot of space, had many parts, and was difficult to install because the engine and the pump had to be properly aligned.

As applications for the steam engine increased, the demand for mechanisms to translate reciprocating motion into rotary motion also increased. The problem was first solved by Pickard in 1780 with his invention, the crank-gear. Initially, his invention was used with the Beam Machine, but later a machine with a cross-head was developed.



Watt's steam engine with an epicyclic transmission.

Pickard patented his crank-gear in 1780. Because of this, other steam engine manufacturers could not use the device to convert reciprocating motion into rotary motion. Another solution was needed and would soon be provided.

### Epicyclic Gear Transmissions

James Watt, of the firm Boulton and Watt, solved this problem in 1781 by using the then theoretical principle of epicyclic gearing. In Watt's invention, the central sun gear is mounted on the output shaft and engaged with a planet gear attached to a guide ring. This device was later replaced by a rod. The planet gear is fixed to a connecting rod and thus cannot rotate around its own axis. When the end of the connecting-rod, which at first was connected to one of the ends of the beam, moves up-and-down, the planet gear will circle around the sun gear and, because it does not rotate itself, will give the sun gear a rotating movement.

Watt also produced a mechanism with an internal sun gear, with which another ratio could be achieved and developed a way to connect the connecting rod to a steam engine's cross-head. A steam engine built by Watt's company is on display in the London Science Museum in Great Britain.

### Hypocycloidal Gear Transmission

These developments were followed in 1802 by Mathew Murray's invention of a hypocycloidal gear transmission. The principle can be explained as follows: When a circle rolls on the inside of a larger, stationary circle, a point on the smaller circle will describe a hypocycloid. When the diameter of the smaller circle is 1/3 of that of the larger circle, a regular pattern of three hypocycloids will be present. By choosing a diameter

of the smaller circle that is half the diameter of the larger circle, the hypocycloid is transformed into a straight line going through the center of the larger circle.

By substituting the circles for gears with a ratio of 1:2, a hypocycloidal gear transmission is created. When the piston-rod of a steam engine is connected with a point on the pitch circle of the planet gear, a mechanism is created with which the reciprocating motion of the piston is directly translated into a rotation of the center of the planet gear, for which no cross-head is necessary. Examples of this type of machine can be found in the Birmingham Science Museum and in the Henry Ford Museum in the United States.

### Conclusion

When the patent on the crank-gear expired, the planetary solutions were soon replaced by crank-gears, which are common in many applications today. However, for some applications, the planetary gear transmissions described above are still used. ☉

### J. A. Broekhuisen

is a gear consultant living in Rotterdam, The Netherlands.

#### Tell Us What You Think . . .

If you found this article of interest and/or useful, please **circle 000**.

If you did not care for this article, **circle 000**.

If you would like to respond to this or any other article in this edition of *Gear Technology*, please fax your response to the attention of Charles Cooper, senior editor, at 847-437-6618 or send e-mail messages to [people@geartechnology.com](mailto:people@geartechnology.com).



the **TIME** has  
come



to  
contact

## Perry Technology Corporation

P.O. Box 21/ 29 Industrial Park Road  
New Hartford, CT. 06057  
Phone: (860) 738-2525 - Fax: (860) 738-2455

visit us on-line at:  
[www.perrygear.com](http://www.perrygear.com)

# THE GEAR & SPLINE EXPERTS

We are a precision manufacturer of gears & splines serving all industries including Automotive & Aerospace with services including parts made complete to your print, or tooth cutting only on your blanks. Lot quantities from 1 to 100,000.

We specialize in both breakdown and fast prototyping services, with complete CNC gear inspection on our Hofler ZP630. We manufacture all types of gears and splines to all standards, including metric. Capacities from zero to 48" diameters. Our machining capacities include CNC turning, CNC milling, CNC OD grinding, CNC hobbing & CNC shaping.

Contact us today for a quote

CIRCLE 134



# Gleason Pfauter Hurth Cutting Tools

In the past, you knew us as Pfauter-Maag Cutting Tools. But with the addition of Gleason® bevel gear cutters and Hurth® shaving cutters, we're now able to meet any and all of your gear cutting needs in ways not even Pfauter-Maag Cutting Tools could have achieved alone.

In recent months for example, new tough, heat resistant HSS and

carbide materials, combined with advanced new **POWER LUBE COATINGS™**, have resulted in **POWER CUTTING™**. This new Gleason Pfauter Hurth technology gives manufacturers the ability to produce both cylindrical and bevel gears at speeds many times that of conventional HSS tools. Even better, gears can be cut without the use of coolant, completely eliminating the disposal costs and

safety and health issues associated with wet operations.

It's just one example of how our tooling, experience, and resources will help meet your gear making challenges going into the next millennium.



## Gleason PFAUTER HURTH CUTTING TOOLS CORPORATION



1351 Windsor Road  
Loves Park, IL 61111 USA  
Web Site: [www.gleason.com](http://www.gleason.com)

Phone: 815-877-8900  
Fax: 815-877-0264  
E-Mail: [Sales@gphct.com](mailto:Sales@gphct.com)

Bevel Gear Cutters

Gear Hobs

Form-Relieved Milling Cutters

POWER LUBE COATINGS™

Shaving Cutters

Shaper Cutters

CBN Grinding Wheels