

# Why We Shot INDIANA TOOL/INDIANA GEAR

David Neidig, VP Marketing



In 1998, a customer asked us to shot peen transmission gears as part of the manufacturing process. Since it was a 36,000-piece-a-year job, we were more than willing to comply. We gathered quotes for outsourcing the shot peening, but the freight costs were \$3-\$4 per piece. Rather than let those costs erode our profitability, we set up an in-house shot peening operation. We purchased a 60" diameter Wheelabrator machine, and Wheelabrator trained our operators.

Although it got us started, the transmission gear job we got in 1998 is not why we shot peen gears today. Since then, we have been able to attract new business because of our shot peening capabilities. Many gear engineers are beginning to incorporate shot peening as a finishing process to

put compressive stresses back into the surface of gear teeth. Some want the process done before gear grinding, some want it done after. Regardless of the design, having this in-house capability has definitely been a benefit to our customers.

Interestingly, the markets using this process are growing. We shot peen components for aerospace, transmission, mining, off-highway and other customers.

Shot peening will become more and more common in the gear industry as engineers realize that this metal treatment process will enable them to get more strength out of a gear without increasing its size.

Indiana Tool/Indiana Gear has provided manufacturing services to a global

# Peen Gears

Indiana Tool – Indiana Gear Manufacturing Capabilities		
Process	Capacity	Tolerance
Gear Shaping	Up to 72" (1,800 mm) diameter and 15" face width (400 mm)	AGMA Class 8, DIN Class 10
Gear Hobbing	Up to 60" (1,500 mm) diameter and 56" (1,425 mm) face width	AGMA Class 8, DIN Class 10
Gear Shaving	Up to 24" (600 mm) diameter and 30" (762 mm) face width	AGMA Class 13, DIN Class 7
Gear Grinding	Up to 72" (1,800 mm) diameter and 30" (762 mm) face width	AGMA Class 13, DIN Class 5
Broaching	Up to 25 tons	
Precision Machining Services	Boring, Vertical Machining, Horizontal Machining, Turning, Horizontal Turning, O.D. Grinding, I.D. Grinding, EDM	+/- 0.0005" (0.012 mm) or better on all processes, boring and grinding to +/- 0.0001" (0.002 mm)
Inspection	M&M Gear Analyzer Klingelnberg Gear Tester 100" (2,500 mm) Zeiss CMM	
Custom Gear Drives	Precision machine all housing and gearing components, provide full inspection data, assemble, and spin testing.	

market for nearly 50 years. We provide precision machining services from one piece prototypes to volume production pieces of up to 1,000 units per month. Our capabilities range from mining gearing to production runs of CBN-ground transmission gears.

One of the highlights of our gear manufacturing facility is our Pfauter-Kapp gear grinder. Not only can this machine grind coarse-pitch external gearing, but it can also grind internal helical gearing. Customers have taken advantage of this unique capability in applications ranging from severe-duty planetary systems to high-speed turbine gearing.

We produce custom gear drives with an in-house capability to work through manufacturing engineering problems, precision machine all housing and gearing components, provide full inspection data, assemble, and spin test custom gear drives. Recent projects include:

- High-speed reducers for a jet engine test stand. They have double-helical ground gearing and nickel-plated housings.

- Large pump housing assemblies. After final testing, the pumps went into a large water works project in South America.
- Planetary drives for NASA. NASA is building a robotic manipulator for the astronauts to practice assembling the international space station. These planetaries, which are part of the shoulder gear train, require AGMA class Q14 spur gears and planet gears, and AGMA class Q11 internal ring gears. ■

### For more information:

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# Reference Papers About Shot Peening Gears

To learn more about the shot peening of gears, visit [www.shotpeener.com](http://www.shotpeener.com) to browse its online library for technical papers like these. More than 100 gear-related shot peening articles are included there, and many of them are downloadable as PDF files.

## Shot Peening as a Factor in the Design of Gears

By J.C. Straub

How shot peening increases bending strength and permits design for greater scoring resistance. When a pair of gears is required to operate at high loads or high speeds or both, particularly where weight and size are at a premium, it becomes important to consider shot peening in the design. The greater the required horsepower per pound of transmission equipment, the more vital the design of the gears called upon to do the job. This discussion is concerned primarily with the design of the gear teeth themselves, particularly on spur and helical gears.

## Creating an In-House Shot Peening Specification for Gears, Parts I & II

By M. Lawrenz and I. Ekis

Part I: Whether large or small, companies can take certain steps to ensure reliable shot peening specifications for the gears they process. Learn how in this first of a two-part article. Part II: Understanding less conventional shot peening methods helps manufacturers develop an in-house specification for gears. This article also relates specification to the part drawing.

## Effect of Shot Peening on the Pitting Fatigue Strength of Carburized Gears

By M. Kobayashi and K. Hasegawa

There are many reports to indicate that shot peening is a valid means to improve the bending strength of gear teeth, but there are only a limited number of reports on its effect on pitting fatigue strength, and its mechanism is yet to be understood clearly. The authors investigated the conditions under which pitting of truck and bus transmission gears occurs and conducted a roller pitting fatigue test and a gear pitting fatigue test using spur gears in order to evaluate the effects of shot peening on the pitting fatigue strength of carburized gears. The findings obtained from the tests are listed below: 1) Pitting of carburized gears originates from the intergranular oxidation area on the surface produced by carburizing. 2) Shot peened gears excel in both fatigue limit and fatigue life. 3) Electron microscopy of the sliding surfaces indicated that the residual compressive stress, which develops as a result of shot peening, works to suppress opening (cracking) of the intergranular oxidation layer under Hertzian contact pressure and consequently improves the pitting fatigue strength.

## Shot Peening in the Design of Gears

By J.C. Straub

Shot peening is a process which might well be considered in the design of any machine part required to carry high loads with a minimum size or weight of the overall unit. This

paper represents an attempt to show that shot peening can be used effectively not only to eliminate fatigue failures, but also in design, to increase load carrying capacity per pound of gears, as well as other machine parts. Naturally, any pair of gears designed for high load-carrying capacity involves good manufacturing practice with respect to gear geometry, material, manufacture and metallurgy. As in any other machine part, the improvement by virtue of shot peening will start from the level of quality of the gears without the benefit of shot peening. A few years ago, shot peening of a particular machine part may have been looked upon as evidence that the part in question had at some time given trouble in service by reason of fatigue failures. Today, shot peening is being considered more and more as a means of increasing the allowable fatigue strength in the design of machined parts. The fact that a part is being peened in production does not necessarily imply that fatigue failures have been experienced on that part in the field.

## Fatigue Strength Analysis of Carburized Transmission Gears

By Y. Okada, M. Yoshida, H. Tahara and T. Matsumoto

Improving the fatigue strength of gears is important for compatibility with rising engine power and for minimizing the weight of transmission units. Generally, carburized helical gears are used for automobile transmissions. Nevertheless, there are many unclear points in the relationship between fatigue strength and material factors. Therefore, this report investigates the effects of material factors, such as intergranular oxidation, alloying elements, etc., and the effect of shot peening by examining the fatigue strength of carburized helical gears which are manufactured from various low alloy steels and different manufacturing processes, and additionally investigates the behavior of fatigue cracks.

## Development of High Strength Transmission Gears

By Y. Okada, T. Matsumoto, A. Karvaguchi, T. Tanaka and K. Nishio

High strength transmission gears have been developed for use in the final gear set of front-wheel-drive vehicles. The steel used as the gear material has a higher molybdenum content, allowing more austenite to be retained following carburizing than is possible with chromium steel. As a result, the steel can be subjected to higher intensity shot peening by using harder peening particles, which are projected by an air-nozzle peening system. With this procedure, the fatigue strength of the gears can be increased 1.6 times over that of conventional gears.

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