

A note from us

Last year was more than just eventful for those of us in the US. In the world of business, what began as normal ebbing of economic tides turned into a spiraling plunge with the shocking events of 9/11. Our lives as well as our businesses have not been the same since. Ralph Waldo Emerson wrote, "For the resolute and determined there is time and opportunity." Right now we have been afforded both. As we move into the new year, let's be mindful of what we have gained through the experiences of last year: Insight, Determination, Solidarity. Those are precisely the tools needed to rebuild our trust in the prosperous land in which we live. If we carry our reignited passion for this country into the future with a positive focus and rededicate ourselves to the success of our companies, this may still be the best year yet. At **KAPP**, we are **Geared to Make Things Move!**

# THE **KAPP** REPORT

Winter, 2001-2002



## ZE 630 Goes Global!

[www.nilesze630.com](http://www.nilesze630.com)

By Matthew Baird  
Sales Coordinator and German-English Translator

The new **NILES** ZE 630 Gear Profile Grinding Machine has its own website! [www.nilesze630.com](http://www.nilesze630.com) is a dynamic and user-friendly website designed as an informative tool for both new and existing customers. Because the **NILES** ZE 630 represents a step in a new direction for **NILES** and the **KAPP** Group, we wanted to provide an easily accessible forum for our customers to obtain information about this outstanding and economical machine. The site offers everything from general machine information and specifications to customized password protected pages containing online features for ZE 630 owners.

When visiting [www.nilesze630.com](http://www.nilesze630.com) you will first arrive at a start-up page where you may quickly navigate to different areas of the site such as the ZE 630 homepage, the customer login page, our Boulder contact information and links to **KAPP** and **NILES** worldwide. Once at the homepage you may choose

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## Gear Root Grinding

By Thomas Schenk  
Applications Engineering Manager

Hertzian pressure and bending stress are the two main factors limiting the load carrying capability of a gear. While Hertzian pressure applies to the contacting flanks only, bending stress reaches maximum values in the tooth root area. Because the condition of the root area is critical to the bending strength, advantages and disadvantages of root grinding are controversially discussed within the gear industry. Before examining individual conditions in detail, let's look at different hard gear finishing processes and their capabilities with regard to machining the tooth root area.

Compared to Coroning or other honing-type processes where root machining is not possible, the continuous generating process using worm wheels can grind the root area to a certain extent albeit with geometrical limitations. The hard gear finishing process that offers the highest degree of root grinding freedom is gear form grinding. With the exception of undercuts, almost every imaginable root form can be realized by form grinding, both with non-dressable CBN grinding wheels and vitrified aluminum oxide wheels.

The common processing alternatives for gear form grinding are; flank grinding only, grinding of flank and fillet without touching the root, and full form grinding where both flanks, the fillets, and the root are ground at the same time. The different root

Want to know more?



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forms of the grinding wheel are typically defined by three parameters: start of active profile, wheel root diameter, and wheel fillet radius. In order to create a smooth transition between the ground flank or fillet and the root surface that is not ground, the maximum possible fillet radius for a given start of active profile and wheel root diameter is usually applied. What then are the arguments for and against root grinding? Why do some people choose to grind the root, and others do not? Why is root grinding at times required and other times prohibited? These are questions we hope to answer.

Due to heat treatment distortions and tooth thickness variations from hobbing, it is impossible to achieve ideal conditions where the protuberance is evenly removed resulting in a smooth transition between the ground flanks and the untouched fillet. Therefore we grind the tooth root area to avoid notches and steps and their negative impact on tooth bending strength. Plus, it allows full control over the form of the highly stressed tooth fillet. Opponents of root grinding argue that removing the hardened surface layer of the fillet weakens the gear tooth and reduces the tooth bending strength so much so that it cancels out any possible benefits achieved by controlling the fillet form. Of course, this depends on specific conditions such as gear design and load characteristics. Additionally, the risk of undefined stock removal in the root area is viewed as a disadvantage of root grinding, which makes it essential to carefully control the stock conditions in this area in order to avoid too much local heat that could harm the surface layer and limit overall load carrying capacity.

Two more aspects to consider when weighing the advantages and disadvantages of tooth root grinding are the residual stress conditions of the fillet and the enormous potential for increased bending strength as a result of a fillet form optimization.

Due to the high mechanical impact and the excellent heat conducting capabilities of electroplated CBN grinding wheels, these tools are able to create compressive residual stresses in the workpiece surface layer. These specific stresses are desirable because they neutralize tensile stresses which result from external load on the part. For gears it means that compressive residual stresses in the fillet area reduce the maximum bending stress and therefore increase the load carrying capacity of the gear. This mechanism is the main reason for shot peening gears. While it is not possible to achieve similar amounts of compressive residual stresses from shot peening by CBN grinding, the tooth load capacity of test gears could be increased by 20 % compared to reference gears which had not been ground but had exactly the same geometry.

Fillet form optimization by means of Finite Element Analysis (FEA) represents another significant potential for increasing the load carrying capacity of gears. Compared to conventional fillet forms such as trochoid and circle, tooth bending strength can be improved by 30% or more with stress optimized fillet forms. However, there is the unsolved problem of geometrical limitations of today's soft gear cutting processes. As an uneven removal of the hardened zone in the root area can have a negative impact on the load carrying capacity, these limitations also limit possible fillet forms after grinding. Only the combination of two processes for pre-profiling and finishing that both provide large freedom regarding the fillet form will allow a full exploitation of the described potential. Current developments in high precision gear forging are promising and could together with gear form grinding contribute to an optimum manufacturing solution for highly loaded gears.



## Erich's Tips from the Top!

### VAG, VAS & RNS tips:

Checking your oil mist lube system for spindle bearings in grinding spindles and grinding arms can be a cost saver. The air pressure on the oil mist should ideally be adjusted to approximately 1.5 bar. The oil flow should be adjusted to approximately 6 drops/minute for the grinding spindles and 30 drops/minute for grinding arms. Accurate adjustments can prevent damage to these bearings. Also keep an eye on the tooth belts for cracks and wear marks. Replacing these before there is significant wear keeps the machine running more efficiently. More tips on these machines to come!

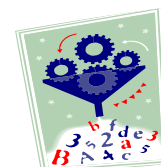
*Have a question? Erich Boehm is a professional Service Engineer with 40 years of experience with KAPP machines. Write to us and we will publish your question and Erich's answer in a future issue of*

### THE **KAPP** REPORT

*ERICH BOEHM –TIPS FROM THE TOP  
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#### **Editor's note:**

*In December 2001 Erich celebrated his 40th year working for KAPP. Thank you Erich, for the dedication you give us and the supreme service you give to KAPP Technologies customers!*



Wishing you a  
very prosperous  
New Year  
from all of us at  
**KAPP**



**A Silent Tribute for United States:** On September 13 at 10:00am people in the region surrounding Coburg, Germany observed 5 minutes of silence in a moving show of solidarity and sympathy for the victims of the September 11th terrorists attacks. All public transportation, government offices, employer associations, unions and many businesses participated in the vigil including KAPP GmbH employees who banded together in one room in solemn remembrance for the lost US citizens.

**KAPP Math**  
 Quality Machines  
 + World's Finest Tools  
 + Worldwide Service and Support  
 = **SOLID SUCCESS!**

### **KAPP KomEdy**

*By our favorite whacky parts guy, Dustin Roberts*

A machinist at an auto manufacturer in Detroit became a Christian and was Baptized. With his conversion he felt the need to make restitution for past criminal deeds. One day he brought in all of the parts and tools he had stolen from his company and asked for forgiveness. The CEO of the company who was in Europe at the time was cabled of the unique situation. He immediately replied with this command: "Dam up the Detroit River and Baptize the entire city!"



## **Our Customers Count**

visit [www.rileygear.com](http://www.rileygear.com)

"Value Engineering" has been Riley Gear's approach to manufacturing precision gears and other transmission components for over 55 years. "Value Engineering" provides Riley's customers with a series of value-added services from collaborative/interactive design to pre-design engineering, prototyping and full production. Utilizing two east coast facilities that total over 95,000 square feet, Riley produces complete gears as well as providing services such as hobbing, shaping, shaving and grinding. They have the capability of producing gears from .25" to 55" pitch diameter and beyond AGMA class 15 or DIN 3 specifications. A NILES ZP 12 machine enables Riley



to offer custom gear box design and assembly as well. Riley's services will expand in May of 2002 with the addition of a new NILES ZE 630 machine- a "Plug and Play" machine tool representing the latest in form grinding technology. Riley Gear is a registered ISO 9002 supplier and meets or exceeds MIL-1- 45208 and MIL- C- 45662 requirements. Always on the cutting edge of the gear manufacturing industry Riley Gear will continue to excel using state-of-the-art machine tools, a professionally trained staff, a fully equipped quality assurance lab and outstanding customer service.

**RILEY**  
**GEAR**

## **The Upshot Abroad**

### **Nodular Cast Iron: The Base Material of Choice**

*By Dr. Frank Reichel , Chief Engineer, NILES; translated and edited by Matthew Baird*

DETERMINING THE BEST MATERIAL TO USE FOR KEY STRUCTURAL COMPONENTS OF A GRINDING MACHINE IS A CRITICAL DECISION FOR MACHINE DESIGNERS. HISTORICALLY, MACHINE TOOL DESIGNERS HAVE USED CAST IRON FOR MACHINE BEDS AND COLUMNS BUT IN THE 1980'S A NEW MATERIAL CALLED CONCRETE POLYMER WAS DEVELOPED PRIMARILY BY STÜDER, A SWISS CYLINDRICAL GRINDING MACHINE COMPANY. CONCRETE POLYMER EXHIBITS CHARACTERISTICS SIMILAR TO CAST IRON BUT AT A SUBSTANTIAL COST SAVINGS. CONSEQUENTLY, MANY MACHINE TOOL BUILDERS HAVE INCORPORATED CONCRETE POLYMER BEDS IN THEIR DESIGNS.

THERE ARE MANY SIMILARITIES BETWEEN CAST IRON AND CONCRETE POLYMER. BOTH EXHIBIT EXCELLENT DAMPING WHICH CAN BE FURTHER ENHANCED BY USING HYDROSTATIC GUIDEWAYS. PLUS, WHILE THE RATE AT WHICH CONCRETE POLYMER GROWS OR SHRINKS WITH TEMPERATURE IS SLOWER THAN CAST IRON, THE COEFFICIENT OF EXPANSION FOR EACH IS SIMILAR. ALSO, BOTH BEHAVE VIRTUALLY THE SAME WHEN FLOODED WITH COOLANT AS IS REQUIRED ON PROFILE GRINDING MACHINES WHERE BEDS MUST REMAIN COMPLETELY STABLE.

DESPITE THE POPULARITY OF CONCRETE POLYMER, WE'VE DETERMINED THAT AN ENHANCED FORM OF CAST IRON, A NODULAR OR DUCTILE CAST IRON DEMONSTRATES ADVANTAGES THAT FAR OUT-

WEIGH THE COST ADVANTAGE OF CONCRETE POLYMER. CAST IRON IS SIGNIFICANTLY MORE RIGID THAN CONCRETE POLYMER AND IT REMAINS STABLE OVER TIME PREVENTING GUIDE WAYS AND SURFACES FROM DEFORMITIES TYPICALLY SEEN AFTER CONTINUED MACHINE USE. FURTHERMORE, IT IS CONSIDERABLY LESS DIFFICULT TO MODIFY CAST IRON THAN IT IS TO MODIFY CONCRETE POLYMER AFTER MOLDING. THIS MAKES SLIGHT DESIGN CHANGES SUCH AS POSITIONS OF THREADED ATTACHMENT POINTS ACHIEVABLE WITH CAST IRON – NOT SO WITH CONCRETE POLYMER. PERHAPS THE BIGGEST ADVANTAGE OF CAST IRON IS ITS ABILITY TO TOLERATE TENSILE STRESS, MAKING DAMAGES DURING TRANSPORT, FOR EXAMPLE, LESS LIKELY. FINALLY, BECAUSE MANY CONCRETE POLYMER BEDS ARE MOLDED SOLID TO ACHIEVE RIGIDITY, CAST IRON STRUCTURAL COMPONENTS ARE MUCH LIGHTER, RESULTING IN DECREASED TRANSPORTATION COSTS AND INCREASED FLEXIBILITY.

WE CONTINUALLY STRIVE TO DEVELOP AND IMPLEMENT NEW AND INNOVATIVE MATERIALS AND COMPONENTS IN OUR DESIGNS AND WILL ALWAYS RESEARCH NEW MANUFACTURING PRODUCTS THAT BECOME AVAILABLE. BUT IN WEIGHING THE ADVANTAGES AND DISADVANTAGES OF CONCRETE POLYMER, FOR STABILITY, RIGIDITY AND LONG LASTING MACHINE BEDS AND COLUMNS, NILES HAS CONCLUDED THAT A HIGH QUALITY NODULAR CAST IRON BASE DISPLAYS THE BEST PHYSICAL PROPERTIES FOR OUR CUSTOMER'S NEEDS, AND REMAINS OUR BASE MATERIAL OF CHOICE.



to take a “virtual” tour of the ZE 630 machine by launching the “flash demo” or choose the “machine features” link to read descriptions of the special features of our new machine. Included on the homepage are also links to a page dedicated to how the ZE 630 concept began and also a list of machine specifications such as stroke length, table load and space requirement. The “machine specifications” page also includes a diagram of the working area of the machine.

The “Customer Pages” are a special feature of the site which come as an added benefit for ZE 630 owners. Using a username and password, ZE 630 owners have quick access to an online copy of their machine documentation, a quick-start guide for machine operators and direct

links to our service and applications engineering teams. Additionally, ZE 630 owners may order spare and wear parts for their machine using a simple online parts catalog similar to shopping at many other online shopping sites. Furthermore, if desired, ZE 630 owners may store their **KAPPNILES** tooling data online in a protected database for easy access for both the owner and our tool engineering department here in Boulder.

The new **NILES** ZE 630 website [www.nilesze630.com](http://www.nilesze630.com) will soon be available in German and potentially other languages as demand increases. We are proud of this in-depth look at our exciting new machine and we hope you will take the time to see what the site has to offer.

## Good-bye Mr. Luft

*Leaving a legacy of humanity, warmth and untiring ambition behind, 73 year old Roman Anton Luft, former Managing Director of KAPP GmbH for 54 years died September 21, 2001. Mr. Luft dedicated his life to what he called “his company” by working from the ground up. Without a formal degree but with a great deal of tenacity he became one of the major driving forces behind KAPP’s success. He made friends all over the world with his personally engaging, highly moral business practices and will be remembered for years by all who knew him.*

