

# GLOBAL SOLUTIONS

GLEASON CORPORATION • KEEPING THE WORLD IN MOTION™

## GEMS software at ZTMW

WANGCHENG, CHANGSHA,  
HUNAN, CHINA



**Company:** Zhongnan Transmission Machinery Works (ZTMW)

**Location:** Wangcheng, Changsha, Hunan China

**# of employees:** 2,900

**Plant size:** 420,000 sq. meters

**Major Products:** Gears and gearboxes for aerospace industry worldwide

**Certifications:** ISO 9001

*China's Zhongnan Transmission Machinery Works (ZTMW) uses Gleason Expert Manufacturing System, PHOENIX® machines and Gleason-Mahr Gear Inspection System to gain global aerospace gear business.*

**C**ompeting for aerospace gear business in today's global marketplace requires sophisticated technology and years of practical hands-on experience. Only a relative handful of precision jobbers around the world can claim to have both.

Rarer still is the ability to produce extremely high-quality aerospace gears both quickly and economically, since months of trial and error and thousands of dollars are often invested before the very demanding performance criteria are met.

**Introducing Zhongnan.** It might surprise you, then, that one of the companies fast emerging as a global force in the production of these high-quality aerospace gears is China's Zhongnan Transmission Machinery Works (ZTMW), a state-owned gear manufacturer in Wangcheng, Changsha, Hunan. Since the 1960s, ZTMW has been a leading producer of gears and other transmission components for



turboprop, turbo-shaft and turbo-jet engines – but predominantly for domestic consumption. But today, armed with a powerful array of advanced new Gleason technology, ZTMW is poised to become China's leading producer of aerospace gears for use by some of the world's best known aerospace companies.

“Pay a visit to ZTMW today and you'll be surprised to find bevel gear producing technology on their shop floor as good as anything anywhere in the world for the production of aerospace gears,” says Gleason Technical Sales Manager (Asia Pacific) George Grana.

“They have positioned themselves for fast, reliable, economical production of these gears and companies around the world are beginning to take notice.”

**World's first complete GEMS system.** Since the late 1990s, ZTMW has been investing in the latest generation of PHOENIX® series 450HC and 1000HC bevel gear cutting machines. They have also invested in 275G, 450G, and 800G grinding machines in order to produce a wide range of precision spiral bevel gears and hypoid gears. Accuracies achieved are of aircraft gear quality. Most recently, the company has added an advanced Gleason-Mahr GMX 600 Gear Inspection System – and the Gleason Expert Manufacturing System, called GEMS.

“With the addition of the latest WINDOWS® based GEMS, ZTMW becomes one of the first companies in the world to bring all its Gleason machines and metrology equipment together in a true closed loop network,” says Mr. Grana. “Their ability to seamlessly communicate and exchange information from design

to manufacture to inspection over an error-free transparent network is tailor-made for the stringent, requirements of aircraft gear manufacturing.”

GEMS is a collection of software programs that work together over a network. This technology allows the new Gleason WINDOWS®-based bevel gear software (CAGE4WIN, G-AGE4WIN, and Summary Manager) running on engineering workstations, to communicate and exchange information with software running on Gleason machines.

Here's how it works:

1) ZTMW's design engineers use CAGE4WIN – a bevel gear design tool – to input basic gear parameters, tooling, manufacturing methods and machinery. By using CAGE4WIN, a Tooth Contact

by a certain gear tooth geometry. Loaded TCA also can be performed. Analysis (TCA) can be performed to predict the contact pattern achieved to predict how the gear will perform under load. CAGE is also compatible with Finite Element Analysis software, should advanced simulation of designs under load or other conditions be required.

2) CAGE automatically creates the dimensional sheet calculations, undercut checks, ease-off plots and summary calculations required by the PHOENIX® cutters and grinders to produce the part. The PHOENIX® Summary Manager additionally allows users to manage summary data either offline at an engineer's workstation or online at the machine. In addition, inspection information is sent to the GMX 600 Inspection system to generate an inspection file.

### GEMS at ZTMW



*Gear designers use CAGE4WIN to create a bevel gear design, machine summary and define how parts will be inspected for flank form and corrected.*



*PHOENIX® Summary Manager program electronically transfers machine summary and tooling information to the PHOENIX® machines.*



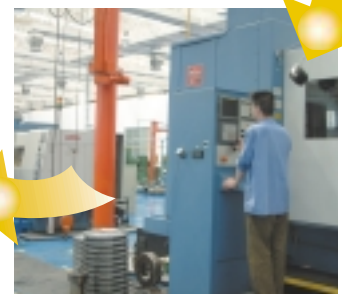
*PHOENIX® 450HC and 1000HC Bevel Gear Cutting Machines cut precision spiral and hypoid bevel gears.*



*G-AGE Enterprise Correction Program automatically calculates machine corrections, which are then reverse engineered in CAGE4WIN. Operator applies corrections to summary.*



*Gleason-Mahr GMX 600 Inspection System measures flank form errors...*



*PHOENIX® 275G, 400G and 800G Grinding Machines perform hard finishing operations.*

3) The first part cut or ground on the PHOENIX® machine is transferred to the GMX 600 for flank form inspection. Then, the G-AGE4WIN correction program is used to automatically calculate PHOENIX® machine summary changes based on the flank form errors measured and compared to either a theoretical flank form grid, or a digitized flank form grid (i.e. electronic master). These machine summary changes are then electronically transferred back to the PHOENIX® machine which manufactured the gear. The machine summary is modified and a second gear manufactured to the revised summary settings. This closed loop manufacturing process typically requires just two iterations to optimize the flank form geometry.

Once the desired tooth contact pattern and location is achieved, flank form measurements of the developed master gear can be utilized to define the theoretical tooth contact pattern from the TCA closely matching the actual tooth contact pattern of the developed master gear. This is accomplished using calculations and communication between the G-AGE4WIN and CAGE4WIN software over the local network. The reverse design in CAGE4WIN can then be used for analysis using higher level software tools such as the Gleason Finite Element program.

“Much of the time, trial and error and waste that is inherent in the design and manufacture of aircraft gears has been eliminated,” concludes Gleason’s Manager of Research and Development Ron Dafoe. “Achieving an ideal contact pattern, let alone repeating it over hundreds of production parts, used to be a process more akin to a ‘black art’. The cutting of parts, roll testing, more cutting, more testing – all come with the potential for significant human error along the way. With GEMS, we’ve been able to integrate even the older Gleason machines into a closed-loop system which minimizes guesswork, and maximizes productivity by a factor of three or four over the old way.”

## Connecting to ZTMW half a world away

*Helping ZTMW get the most out of its new GEMS installation would have been challenging enough even if the customer had been just down the street – let alone half-way around the world. Gleason recognizes that great products alone aren’t enough – it takes a great service apparatus to make them work. That’s why, in addition to the close local support provided by its China office, Gleason is also employing technology resources like Control-F1, a web-enabled software solution that accelerates the “live” support process by improving Gleason technicians’ remote access to customer systems and speeding communication, symptom diagnosis, repair and documentation.*

*For example:*

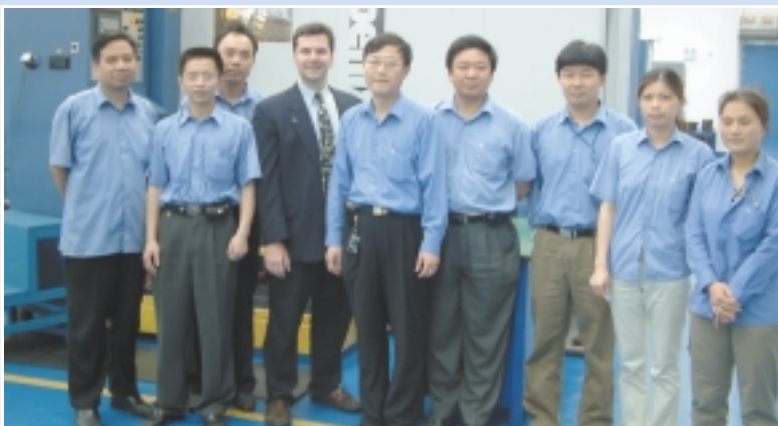
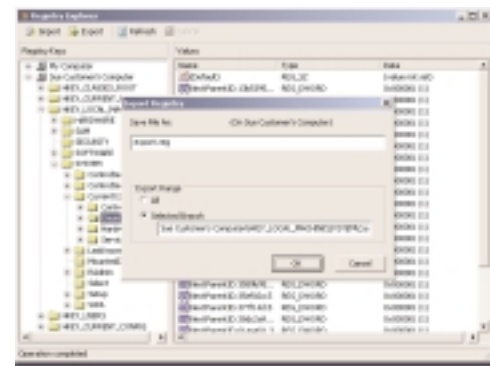
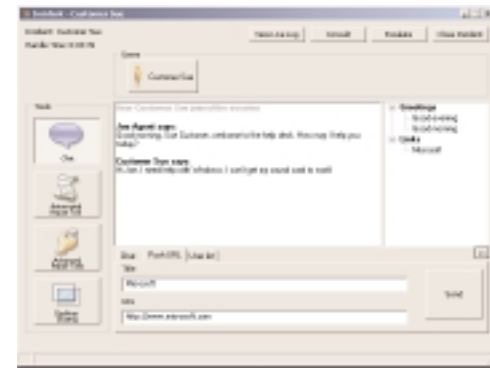
- Collaboration tools such as Live Chat and Desktop Sharing provide the platform for enhanced remote interaction between technicians and customers.

Collaboration can occur between multiple technicians and customers.

- Information retrieval is automated. Predefined details about a customer’s computer are gathered instantly and accurately.

Technicians can automatically access information on operating environment details, memory, and the status of currently running applications, installed applications, installed devices, and network devices.

“We needed a secure, web enabled, multi-platform solution to allow us to support ZTMW with communications, training, and support – all in realtime from Rochester,” says Gleason’s Mr. Dafoe. “The solution also had to be scalable in order to support future needs such as diagnosing problems that occur in China, and then correcting them from Rochester just as if our engineers were on-site. Control-F1’s Support Bridge Live Automation solution meets the needs of all of the above.”



# Gleason

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