

# AEROSPACE

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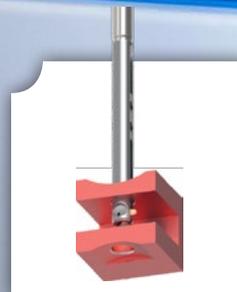
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# SHEET HYDROFORMING TAKES FLIGHT



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# SHEET HYDROFORMING TAKES FLIGHT

Using modern sheet hydroforming technology, Jinpao Precision Industry Co. and Triform partner to expand aerospace forming operations around the world.

By Christie Williams

Jinpao Precision Industry Co. Ltd., Samut Prakarn, Thailand, started in 1998 as a hard-tooling company with an aggressive expansion plan but quickly evolved into a leading job-shop in Southeast Asia specializing in low-volume, high-mix aerospace part production. By 2005, the company moved their corporate headquarters in to a 777,757ft<sup>2</sup> (72,256m<sup>2</sup>) facility near Bangkok and expanded operations to include sheet metal fabrication, stamping, CNC milling, finishing, precision machining, and engineering support services.

In 2008, the owners established a rigorous quality management system (QMS) and became an AS9100-certified supplier in early 2014. This accreditation solidified Jinpao's future in aerospace part production on a global scale. They expect to extend their aerospace division to include a dedicated area specializing in unique manufacturing processes such as stretch forming and deep-draw sheet hydroforming.

"We would like to grow together with our aerospace customers utilizing our diversified capabilities and engineering expertise," says Chung Kuo-Sung "Victor Chung," managing director at Jinpao Precision Industry Co. Ltd. "We need machinery that can easily form complex shapes, and we need to cut costs for extensive tooling in order to be competitive

in the aerospace market."

Among the new machinery in Jinpao's aerospace division is a Triform model 24-5BD fluid cell sheet hydroforming press manufactured by Beckwood Press Co., St. Louis, Missouri. With a 24" diameter forming area and 5,000psi of forming pressure in a 58" x 100" flush-floor design, Jinpao's Triform press offers versatility without the need for special foundations.

"Originally, we were using conventional stamping machines to form sheet-metal parts," Chung says. "These methods are prone to tooling marks, wrinkling, scratches, and other cosmetic defects. Because of these issues, we started looking for an alternative method of forming parts without the disadvantages of cold forming."

Suitable for low-volume, high-mix part production, Jinpao's new Triform press has become a critical component in the company's state-of-the-art forming facility. "The Triform team is very supportive," Chung says. "Their sales, application, and engineering teams are very helpful to a new-entry company in this industry. We ultimately chose Triform because of their total solution."

Today, Triform machines are frequently used in the aerospace and defense industries where low volume, high-mix production is common. Job shops such as Jinpao as well as

manufacturers in the automotive, medical, lighting, energy, and oil & gas industries are discovering competitive advantages in the sheet hydroforming process.

## Two forming processes

Sheet hydroforming presses typically fall into two categories: fluid cell and deep-draw. During the fluid cell process, blank sheet material is placed on a single, unmat-ed tool resting unsecured on the working surface. A pressurized diaphragm extends over the tool and blank, exerting equal pressure on every square inch of the part's surface. Even application of pressure offers net shape part production – minimizing wrinkles, improving part definition, and reducing hand finishing.

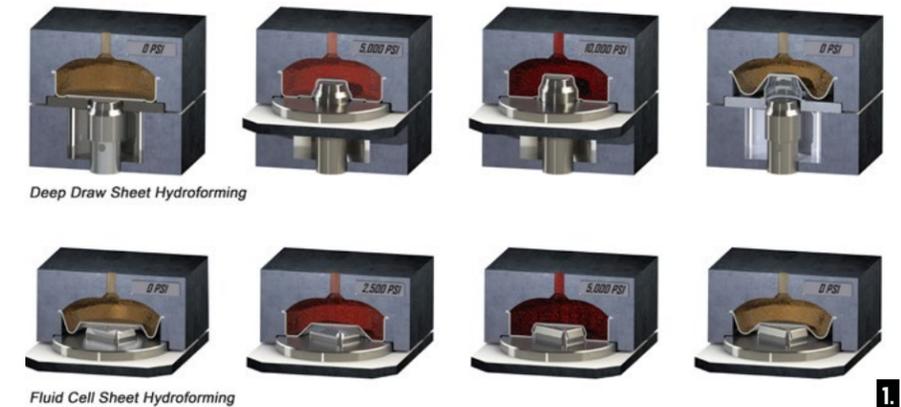
Deep-Draw sheet hydroforming is often used for applications requiring a controlled flow of material, such as drawn parts or those with the potential to wrinkle during formation. During the deep-draw process, a pressurized diaphragm holds a blank in place as the tool extends on a hydraulic punch cylinder. This draws the material into the diaphragm and allows it to flow as needed.

The diaphragm's uniform pressure exertion is optimal for creating complex geometric shapes which are difficult using traditional forming methods. Parts that normally require multiple steps or expensive progressive dies can often be formed in a single cycle through sheet hydroforming.

## Technology application

The Triform line of sheet hydroforming equipment was developed in 2008 in response to market demand. Reliable sheet hydroforming equipment was extremely scarce, and prices reflected the lack of competition. Used equipment was often a half-century old and presented countless hazards.

"Cincinnati and Verson hydroform machines from the 1950s laid the groundwork for the evolution of Triform," says Bob Blood, hydroforming veteran and Triform technical sales engineer. "We took the



1. Deep-draw (top) compared to fluid-cell hydroforming (bottom). 2. Beckwood's Triform sheet hydroforming press installed at Jinpao Precision Industry Co. Ltd. 3. Checking a part produced on Beckwood's Triform sheet hydroforming press. 4. Sheet parts placed on tooling in preparation for hydroform pressing.



3D printed tool and hydroformed part.

nearly 70-year-old process and infused modern technology to create machines that offer accurate and repeatable forming results.”

Before Triform, most sheet hydroforming control systems used levers and valves that had to be manually adjusted for each

cycle. Skilled operators and secondary finishing were necessary, and part inconsistency and high scrap rates were frequent by-products.

“Using modern technology, we took sheet hydroforming from an artform to a science,” Blood recalls. Triform presses

control diaphragm pressure to 1% of full scale and punch position to  $\pm 0.002$ ". Up to 30 steps can be saved per cycle, and more than 10,000 unique recipes can be stored for later recall.

### Un-mated tooling

“With sheet hydroforming, we can form complex designs without the need for extensive tooling,” Chung says. “We were able to cut tooling cost in half because the diaphragm serves as the female die.”

Additionally, Triform tooling can be made from a variety of materials including steel, aluminum, 3D-printed substrates, poured epoxies, and even wood – expediting tool and part development and reducing research and development (R&D) costs. Non-mated tooling also allows for faster setup and change-over, particularly within the fluid cell process.

“Operation time is also reduced significantly because of its ability to form multiple parts in a single cycle,” Chung notes.

### Forming the future

Jinpao is currently seeking process qualification and first article inspection (FAI) using the sheet hydroforming process to manufacture aluminum aerospace components. Upon receipt of the certifications, management intends to seek Tier 1 supplier status with Boeing and Airbus and expand production to include titanium, Inconel, and other high-strength alloys.

“Currently more than 20% of our annual sales revenue comes from the aerospace industry,” Chung explains. “With the help of Triform, we expect to significantly increase this amount during the next five years.”

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