

### **Better, More Cost Effective Tube Bending**

*Thomson roller bearings deliver smaller size, shorter lead times and 30% lower costs - without any significant reduction in load capacity*

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Pines Technology, Westlake, Ohio, makes computer numerical control (CNC) tube benders for the power generation, ship building, petro-chemical, heavy truck and many other commercial industries that bend pipe up to 14 inches in diameter for cold bending, and up to 48 inches in diameter for hot (induction) bending. The carriages that move the pipe during the bending process represent a tough linear guide application because they carry heavy pipe (up to 1450 lbs.) that exerts large moments (60000 ft./lbs. of torque) on the carriage as it rotates large lengths (up to 8 m) of pipe in the “B” (rotational) axis.

The 85 mm profile rail guides with ball bearings originally used on the company’s CNC-150 bending machine were robust but expensive, took up a lot of space and had long lead times. On subsequent versions of the CNC-150 and on the newer CNC-250, Pines switched to 65 mm 500 Series Thomson Roller Linear Guides. These bearings having a similar dynamic load carrying capacity (295,000 N) as the larger ball bearings but cost 30% less - and also are available in stock for immediate delivery. The 65 mm 500 Series roller linear guides also weigh 36% less than the 85 mm profile rail guides, reducing overall machine weight and simplifying material handling.

Material is manually placed onto a material loader on the Pines CNC-150 and CNC-250 bending machines. Arms lower the material onto powered tube supports that feed each piece through a carriage. A laser identifies the end of the material and this information is used by the control system to precisely position it at the start of the bending process. The carriage moves the part into position for the bend and then releases the part.

To start the bending process, the tube is locked against the bend die by the clamp die. Then the pressure die activates to contact the tube outside diameter surface with a fixed amount of load applied. Once the position of the pressure die is locked, the swing arm rotates to bend the tube. The pressure die travels with the part during the entire bending process. Booster force is used to apply a positive push to the pipe being bent to minimize distortion of the cross-section and reduce the amount of wall thinning along the outer radius of the bend.

Pines uses computer simulation of the bending process to optimize the magnitude and timing of the boost pressure that is applied during the bending process to minimize wall thinning and ovality. For example, it becomes increasingly easier to detach the tube from the bend die as the bend progresses so the boost load must be decreased during bending. When the bend is completed, the carriage grips the pipe again and moves it to the next bend position. Rotations between each bend add another load dynamic to the forces the bearings must handle.

“Our first customer for the CNC-150 machines had problems with another supplier’s bending machines due to failures in the carriage bearings,” says Daniel Auger, Director of Engineering at Pines Technology. “We carefully selected 85 mm ball bearings for early versions of our CNC-150 machine and their performance was good, although their cost was high. Later, we decided to see if we could get equal performance at a lower cost and looked at Thomson 500 Series roller profile linear guides.”

500 Series linear guides use roller bearings that can provide more than 1.5x greater load capacity than ball bearings because a ball provides only single point contact area, while a roller provides a much greater line contact area. This results in substantially higher load carrying capacity and lower wear with minimum rolling friction, and enables machine builders such as Pines Technology to reduce the carriage/rail size when employing a roller carriage.

“The 65 mm 500 Series roller linear guide provides a similar load rating as the 85 mm diameter ball linear guide that we had used on the first few machines at half the cost. Another advantage of the 500 Series is that it is an off-the-shelf item that is stocked in the United States for immediate delivery while the ball bearings that we used in the past involved much longer delivery times. We have used the 500 Series on all subsequent CNC-150 and on our newest CNC-250 machines and they have provided excellent performance without any failures or maintenance issues,” Auger concluded.