

Moving Heat Treating In-Line

Single Piece Flow Streamlines Production for High-Volume Gear Manufacturers

Randy Stott, Managing Editor

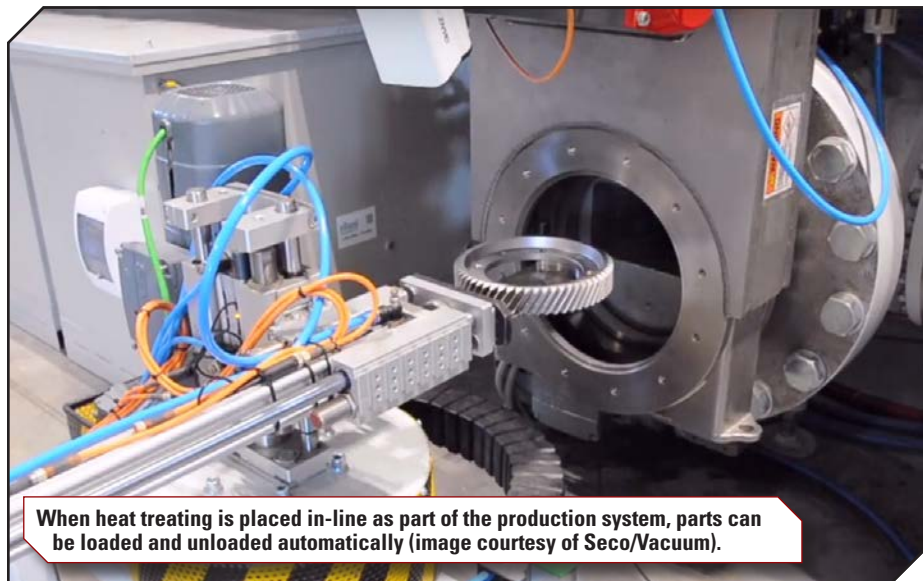
Over the past decade, low pressure carburizing (LPC) combined with high pressure gas quenching has come to dominate the heat treating of high-volume automotive transmission gears. The reasons are simple: minimized distortion and highly controllable case depth. But today, those processes are becoming even more efficient, automated and controllable, and they're beginning to move out of the heat treat department and directly into the production line via a concept known as single piece flow.

"While case hardening with LPC has been around for several years, the ability to process parts one at a time in extremely consistent environments is relatively new," says Maciej Korecki, vice president for global vacuum technology at Seco/Warwick (represented by Seco/Vacuum in the USA). "Single piece flow is proving to be of significant interest to leading companies in aerospace, automotive, transmission, robotics and electrical drives."

Seco/Warwick has been working on the concept for about five years, and the company is scheduled to install its first production-scale equipment at a major automotive manufacturer in 2020. The company's UniCase Master system is designed for case hardening gears in a one-piece flow system. Each part is processed individually to minimize distortion and ensure repeatability.

Dennis Beauchesne, general manager of ECM USA, agrees that single-piece flow is the direction high-volume gear heat treating is moving: "We feel that single piece flow with heat treat furnaces that operate more like machine tools... will be the future of heat treating. We see large heat treat departments being replaced with heat treat systems in-line with manufacturing operations."

The concept of single piece flow is not new. The idea goes back to Henry Ford, and it's one of the central concepts



When heat treating is placed in-line as part of the production system, parts can be loaded and unloaded automatically (image courtesy of Seco/Vacuum).

in modern lean manufacturing. By eliminating the waste of moving parts back and forth, quality and efficiency improve.

While that has traditionally been a challenge with heat treating, times are changing, and today's furnace manufacturers are building systems that can be placed in-line with the machine tools.

"This has been the trend for the last 20 years from all the captive gear manufacturers, and we are starting to see it even more from tier 2 suppliers," Beauchesne says.

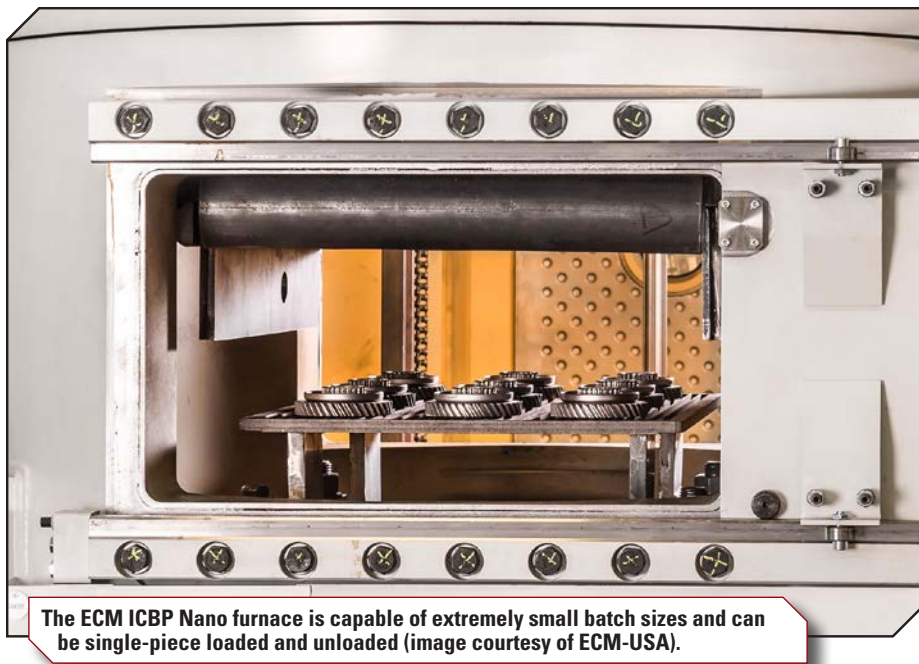
ECM's Nano furnace line is designed for small batch sizes, allowing for better control over case depth, core hardness and distortion. Instead of large batches, where the results vary depending upon the part's location within the batch, these systems provide much tighter control. More importantly, they're designed to be placed right in line with the CNC machine tools.

One of the most important advantages of these small-batch, inline systems is their ability to control the quality of the parts.

"Due to the ability to process gears one at a time in a static environment, distortion is being minimized, eliminating or reducing the need for post-heat treat machining," Korecki says. "Additionally, advances in technologies



The ECM ICBP Nano furnace is designed to be placed in-line like a machine tool (image courtesy of ECM-USA).



The ECM ICBP Nano furnace is capable of extremely small batch sizes and can be single-piece loaded and unloaded (image courtesy of ECM-USA).

have allowed us to precisely control the case depth. In many cases, this results in a shorter heat treating cycle and substantial time and dollar savings.”

Getting heat treating in-line with gear manufacturing creates a number of advantages. One is the ability to automate the process. Instead of unloading parts from machine tools onto pallets, stacks or baskets, the parts are kept

in-line and can be loaded and unloaded via conveyors, robots and automatic grippers. The parts never have to leave the production line, nor do they have to be manually loaded or unloaded.

“Automation is important,” Korecki says. “Gear manufacturers are requiring

heat treating equipment to be automated so there is less chance for human error.”

In addition, automation helps combat the skilled labor shortage so many manufacturers face.

“ECM has now developed a robotics team to work along with our heat treat furnaces to bring the systems into a new level of ease for loading and unloading,” Beauchesne says.

Another advantage is the level of information available on each individual part, from design all the way through testing. In today’s Industry 4.0 world, that level of information is extremely important.

“Gear manufacturers are producing more requirements that link the furnace manufacturers with not only heat treat specifications, but also distortion results as part of the heat treat specifications.

Beauchesne says. “Industry 4.0 has played a role in how furnace companies are looking into the future by using interfaces with the system that can predict maintenance and potential downtime to the system before it happens.

Beyond that, Beauchesne says, the in-line heat treating also introduces



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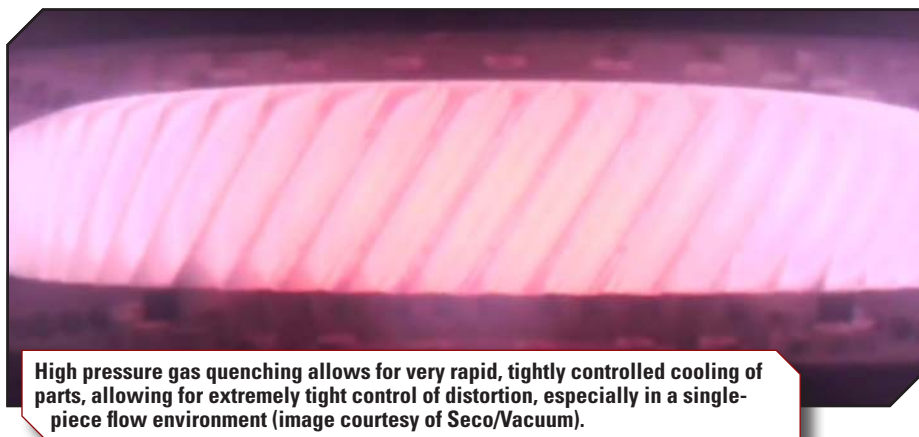
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the possibility of in-line testing and validation.

Korecki also sees testing as an important element of in-line heat treating. "Companies would rather validate the heat treating process in-line than have parts taken off-line for testing. More importantly, more and more manufacturers are requesting single-part monitoring and reporting. Every gear needs to be 100% accurate."

Flexibility is another benefit to in-line, single-piece heat treating. Manufacturers



High pressure gas quenching allows for very rapid, tightly controlled cooling of parts, allowing for extremely tight control of distortion, especially in a single-piece flow environment (image courtesy of Seco/Vacuum).

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want to be able to process a variety of parts – with varying sizes and varying case depth requirements – without having to make major changes to the equipment.

Finally, protecting the environment is a major concern. Today's low-pressure carburizing, high-pressure gas quenching systems are much cleaner than older systems that relied on quenching in oil. Also, because they can easily be turned off and on, and because they use much smaller batches, there is much less energy wasted.

All things considered, the trend toward heat treating with single-piece flow seems likely to continue and improve, says Korecki. "The days of batch processing are numbered in the gear industry because every gear counts." ⚙️

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