

# Drive & Control profile

## Hard disk transport speed gets a big boost from Rexroth linear motion system



The Intevac 200 Lean<sup>®</sup> Gen II system uses a Rexroth linear motion system to increase throughput by 25% to 1,000 disks per hour.

After working with Bosch Rexroth to design a unique linear motion system (LMS) with NYCe 4000 motion control, Intevac's 200 Lean Gen II boosts system throughput by 25 percent over their first generation 200 Lean. Moreover, the system is much easier to maintain, thereby increasing availability for production.

Today's growth in digital data has created a huge demand for hard disk storage media. At the same time, hard disk manufacturers are facing strong price and competitive pressures. That makes it critical

for hard disk manufacturers to maximize throughput. The more hard disks produced by a single hard disk manufacturing tool, the greater the return on investment.

### Challenge

Boost throughput and system availability for production with an improved transport mechanism for second generation hard disk manufacturing system

### Solution

Bosch Rexroth Linear Motion System (LMS) with NYCe 4000 motion control

### Benefits

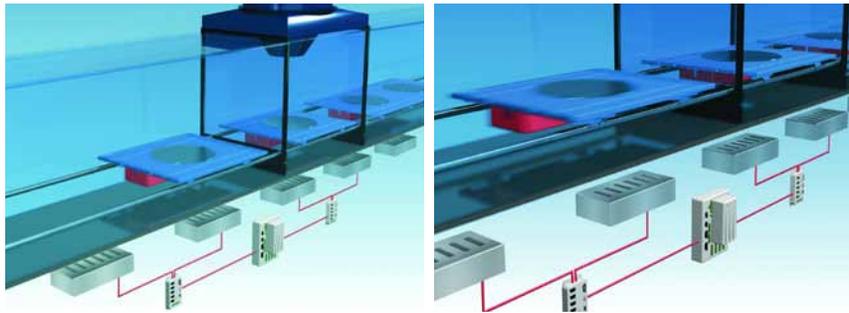
- Linear motion system reduces disk carrier transport time by 50%
- Throughput increases from 800 to 1000 disks per hour, a 25 percent gain over prior system
- System availability for production is dramatically improved with simple rails inside vacuum chambers that require no maintenance and service.
- Mean time between tool servicing is now longer, for more tool uptime.

Intevac, Inc. ([www.intevac.com](http://www.intevac.com)), of Santa Clara, CA, produces one of the leading perpendicular magnetic recording (PMR) hard disk manufacturing tools: the 200 Lean® system. One of Intevac's main goals for their second generation 200 Lean system was to develop an improved transport system that would enable significantly faster throughput. To accomplish this, Intevac engineers teamed up with Bosch Rexroth engineers (Hoffman Estates, IL, [www.boschrexroth-us.com](http://www.boschrexroth-us.com)) to integrate the innovative Linear Motion System (LMS) on Intevac's 200 Lean Gen II system.

#### Higher throughput for film deposition processing

"Higher throughput is the key to lowering our customers' capital costs per disk," says Chuck Liu, Intevac's general manager for hard disk drive products. "We were pleased that Rexroth wanted to work with us to design a transport system that met our requirements to dramatically boost throughput in our 200 Lean Gen II system, enhance system availability for manufacturing operations, and improve product quality for our customers."

Intevac was one of the first companies to successfully bring PMR deposition technology to the hard-disk-manufacturing market. The 200 Lean Gen II system demonstrates Intevac's ongoing leadership in vacuum deposition sputtering technology with a method of depositing thin films of a recording medium onto a glass or metal substrate.



One benefit of the LMS is that there are no rollers or other mechanical drive elements to generate debris—eliminating a possible source of contaminants that could cause defects.

The 200 Lean hard disk sputtering tool is used to produce 3.5- and 2.5-inch hard disks used for desktop and laptop computers, digital video recorders, and other consumer electronics. Throughput with Intevac's first generation 200 Lean is approximately 800 disks per hour. For the 200 Lean Gen II, the Intevac engineering team wanted to see if the Rexroth linear motion system with NYCe 4000 motion control technology could be configured to increase throughput to the level they required for their second generation system.

Each process station inside Intevac's 200 Lean system deposits a specific layer of the media structure, such as a soft magnetic underlayer, an oxide-segregated magnetic layer or a carbon overcoat, depending on the process. The Gen II system can also be used for heat-assisted magnetic recording (HAMR) and patterned media disk processing.

"Most hard disk manufacturers use 20 stations," says Liu. "Rexroth demonstrated that its linear motion system could cut transport time between stations by 50 percent. This increases production from 800 disks

with the 200 Lean to 1,000 disks per hour with our Gen II system—a 25 percent improvement in throughput."

#### Innovative inverted linear motors

Intevac worked closely with Rexroth to define the project and develop the initial control technology and the hardware to create the Gen II transport mechanism.

In the Gen II design, Rexroth was able to move the disk carriers independently from one process to another at high speed and with high precision using a patented, non-contact linear motor drive system.

Standard linear motion systems that use iron core brushless motors employ rare earth magnets in a stationary track, with coils incorporated in a "forcer" that moves along the track.

The Rexroth LMS uses inverted linear motors with coils embedded in the track and a magnetic plate embedded in each disk carrier. The plate on the carrier is then magnetically coupled to the coils, which are located outside of the vacuum chamber. The carrier

moves when the electromagnetic coils are activated in a controlled sequence, passing control of the carrier's magnetic plate from one coil to the next without losing position or control of motion. Thus, the disk carrier moves from one process chamber to another process chamber, passing through a slot valve between the chambers. Perfect carrier hand-offs between stations are enabled by hall sensors tied into a NYCe 4000 motion controller.

The NYCe 4000 system is a compact, multi-axis control system with integrated drive technology. Thanks to its integrated drives, user-friendly tunable software and multi-functional capabilities, the NYCe 4000 system complemented Intevac's 200 Lean modular design. But Liu notes that it also contributed several important maintenance and quality advantages.

### **Less maintenance, more operational time**

"By employing inverted linear motors in the Gen II design, the magnetic plate is integrated into the carrier. Therefore, the coils, electronics and cabling are located outside the process chamber. Servicing the system is much faster, because what is inside the chambers of the Gen II system are simple rails for the carriers to ride on. There are no complex alignment maintenance procedures involved. And because there are no mechanical drive components to cause problems, the mean time between service is much improved," Liu emphasizes.

Another benefit of the LMS is that the drive mechanism does not rely on friction to drive the carriers from station to station, eliminating a possible source of contaminants that could cause defects.

### **Teamwork stands behind the technology**

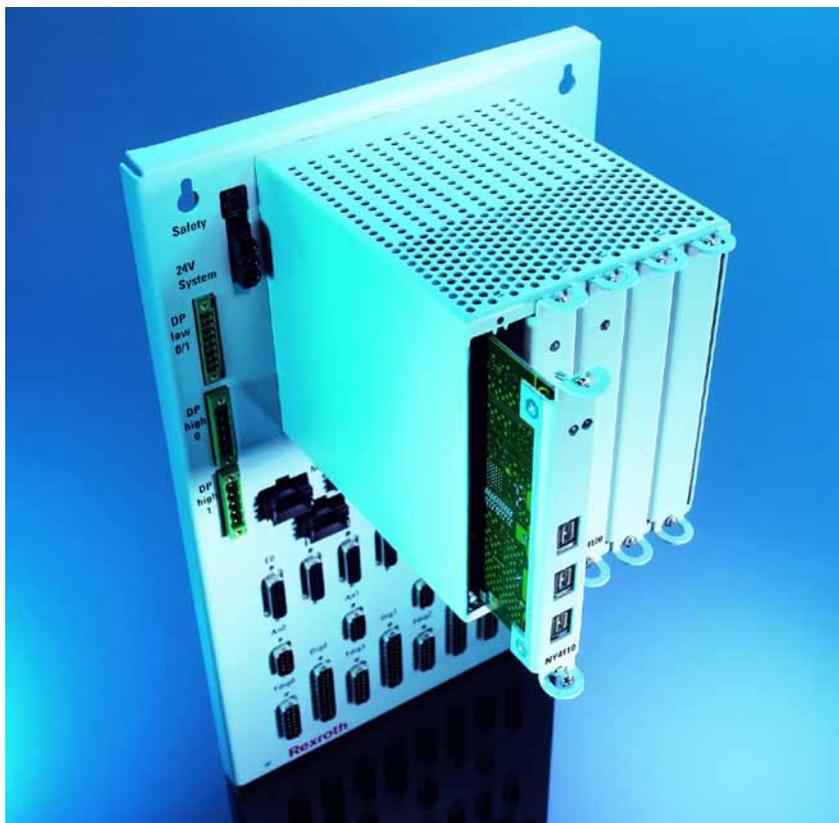
To create the Gen II transport mechanism, the Bosch Rexroth Tech Center West in Pleasanton, CA, worked with the Intevac team through all phases of the project from defining requests to developing initial control technology and hardware, and finally, implementing the testing and system optimization. The dedicated high-tech applications

group provided face-to-face support at critical phases of the project, with Rexroth application engineers writing control code and tuning motors.

At the prototype stage, Rexroth application engineers determined proper coil and sensor placement and control programming to regulate the rate of carrier acceleration/deceleration and ensure vibration-free movement of the carrier during hand-offs between chambers.

### **Custom design assembly to meet safety standards**

When the first 200 Lean Gen II system shipped in 2008, Tech



Thanks to its integrated drives, user-friendly tunable software and multi-functional capabilities, the NYCe 4000 system complemented the 200 Lean system's modular design.

Center West provided a custom control enclosure to meet SEMI standards.

Intevac's customer needed seven enclosures for the 72-volt drive components to meet safety requirements—one enclosure per module. The 200 Lean Gen II system ships in seven modules: one front and one rear module, plus five process modules, each containing four process chambers or stations. The enclosure for each module houses a Rexroth NYCe 4000 node with a backplane, two drives, and two multiplexing units to control four linear motors. The Tech Center created drawings and devised one enclosure design for three mounting variations, complete with strain-relief cables, and had the enclosures fabricated to fit the 200 Lean system's compact footprint.

Today, Bosch Rexroth expedites production of 200 Lean Gen II systems by delivering the LMS

assembly fully wired and tested. After Intevac sells a system, a Rexroth support team is available as needed to support Intevac's customers.

The Rexroth NYCe 4000 motion control incorporates real-time motion control functionality, enabling real time diagnostics. "Data is accessible on carrier acceleration, individual coil history, position following errors, and other important variables, which makes it easy for Intevac to optimize the system or to customize it if needed," Liu says.

"Our relationship with Bosch Rexroth is a partnership," Liu continues. "Given our process chamber geometry, we wanted to see if a linear motion system could meet the needs of the process, plus provide flexibility for other hard disk media. The Rexroth team came through—not just as a component vendor, but as a solutions provider."

**Rexroth**  
Bosch Group