

Variaxis Slices Cycle Time 80% for Semiconductor Equipment

Saint-Gobain Semiconductor Equipment, a precision manufacturing and assembly operation supplying semiconductor equipment, operates on the principle of applying the latest, most-effective technologies to its operations. The time had come for this San Jose, CA company to replace its aging milling centers with new machining technology that would take the company into the future.

Packed to the walls with a variety of machining systems, Saint-Gobain Semiconductor Equipment is a tier one supplier to the semiconductor industry. Most of the work leaving its doors is used to manufacture semiconductor chips.

The many multi-faceted parts being machined at Saint-Gobain typically require several setups on different machines, often with cumbersome pallet and indexing devices. A standard 3-axis mill would not be the technological replacement the company would settle for.

The solution that offered greater capabilities proved to be a multi-tasking machining system from Mazak [Florence, KY]. The Variaxis 200 Multi-tasking system features five-axis movement to lower the setups needed to machine a complete, complex part from several down to one. In addition, its fast rapid travels translated into shorter cycle times, with one job seeing a whopping 80% reduction.

While some of the work has open tolerances, most is machined to tight tolerances and super-high finishes. As a premium supplier, Saint-Gobain builds, assembles, tests, and then ships a complete product. Once the product arrives at the customer's door, the product is ready for installation into their semiconductor manufacturing operation.

Operating weekday shifts in swing operation, and day shifts during the weekend, many of the machines at Saint-Gobain will only see four-hour idle times. To keep up with this demanding schedule and the quickly changing market demands of the semiconductor industry, the company only chooses the most reliable, accurate and capable machining technologies. The chosen systems machine products primarily from 6061 and some 5052 aluminum alloys.

A Simple Solution

It was time to simplify the approach to machining the multi-faceted parts Saint-Gobain required. “The standard 3-axis mills we had already in house worked great,” recalls a Saint-Gobain engineer. “But our more-accurate machines were getting pretty old with some over 12 years old. They were starting to lose some accuracy. It was time for us to move into the next level of machining technology, something that would take us into the future.”

Once the first Variaxis 200 was installed on the Saint-Gobain shop floor, the first test part was a 14”-diameter spun-metal part that required face and edge milling, as well as the drilling and boring of holes at different angles around the circumference of the part. To perform the milling operations, a 3-flute end mill was used at 12,000 rpm and 400 ipm. “We used the side of the end mill,” a shop floor manager explains. “The tool just ripped around the part. After the first machining operation, we couldn’t see any tool marks on the part and its roundness was within 0.0007 in. I attributed that 7/10ths to a bend that existed in the sheetmetal from which the part was formed. If we had started with a solid block on the Variaxis, I don’t think there would have been any out-of-roundness.”

Along with the milling, drilling and boring operations the part required, it also needed the bottom cut off to complete the part. The hope was to use a sawblade cutting tool for this particular operation.

Fixturing and setup were the first order of business. One engineer recalled that when the Variaxis first arrived in the parking lot, he looked at it and wondered how it was going to hold

work. “Its unique layout required some fixturing imagination.” To hold the large-diameter spun-metal part, he attached a 3-jaw chuck to a subplate, then opened the jaws externally to apply pressure to the internal diameter of the part, an approach that worked “real well.”

However, programming now offered some difficulties. Their programmer initially said that they wouldn’t be able to machine the part on the Variaxis due to travel specifications on the machine related to the cut-off operation and the bolt-hole pattern, which exceeded machine travel. Imagination and taking full advantage of the Variaxis multi-axes soon took care of the hole pattern issue. They solved the problem by locating the end mill in one location then rotated the C-axis around to create the bolt-hole circle rather than using the machines axes. As an engineer explains, “The end mill simply pokes right through the part, then walks around to create the hole. How much simpler is that?”

These methods enabled Saint-Gobain to take full advantage of the machining capabilities of the Variaxis while using only one setup: The Variaxis, using the same fixture that was used on the horizontal machine, now machines all the 90° work, then the 45° work, then machines the top of the part. It then cuts off the part. All these operations are completed using a simple rotational movement.

The single setup and continuous machining cycle on the Variaxis was like night and day when compared to the previous machining method. Four different setups on the horizontal machine using a pallet and indexer required additional machining steps and some operator interaction.

Previously, drilling the holes on the horizontal had been a lengthy process. The pallet would move the part into position inside the horizontal mill. Then the table would index to allow the machine to drill the pilot holes for three of the holes. The machine control would then interpolate the boring operation, perform the boring, then finish the holes. The table would index to the next three holes and repeat the procedure—which “seemed to take forever” to the Saint-Gobain engineers.

The transfer of this part to the Variaxis provided many benefits to Saint-Gobain. These included fewer tools to machine the final part, setups reduced from four to one, and dramatically faster cycle times due to faster travel speeds. Today, Saint-Gobain turns out a complete part in 8 minutes, compared to the previous 40 minutes; an extraordinary 80% reduction in cycle time!

A Full House

Today, Saint-Gobain managers keep their eyes open for any part that fits the capabilities of the Variaxis. The parts destined for the Variaxis include multi-faceted, multi-shaped parts as well as block shapes. “Anything that will fit inside the machine and can benefit from the 0 to 1390 ipm rapid traverse possible on the machine will go to that machine before anything else in the facility,” says one. “Every job that comes in, as the print crosses my desk, the first thing I ask myself is ‘Is this a Variaxis part?’. Seriously, my future is to have Variaxis and other Mazak multi-tasking systems only. I can imagine my whole shop filled with them.”

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Photo 1: A 14" diameter thin, spun-metal part uses a 3-jaw chuck for clamping, produces a highly accurate product. Machining takes 80% less time to complete than previously processed.



Photo 2: From four setups to one for this aluminum bracket, starting out at 30 pounds it finishes up at 5lbs with the cycle time cut in half.



Photo 3: Mazak Variaxis 200 5-axis machine completes complicated parts in a single fixturing.

