

## Mazak Technology Fuels NASCAR Winners



“Everyone loves a winner, and today, technology drives the winners in stock car racing,” said Don Miller, President Penske Racing South Inc., the team that fields cars for NASCAR Nextel Cup drivers Rusty Wallace, Ryan Newman, and Travis Kvapil.

“Today NASCAR is so competitive that we need even the smallest difference in technology to give us a winning edge. On any given race day you have 25 cars that can win a race. Today the margin is minute between winning and finishing in the top five. Years ago the winner of a race could be half a lap ahead of the second place car and an entire lap ahead of the third place car. Now you could throw a blanket over the top 10 cars as they come across the finish line after a 500-mile race. And there are 60 cars fast enough to qualify for one of these races and they run two tenths of a second apart from first place to 60<sup>th</sup> place. Hundredths of a second separate the top 20 cars. You don’t have any margin for error. This isn’t rocket science, but it’s the next best thing to it,” said Miller.

He added, “One way that NASCAR and any racing team gains a competitive edge is to build their own parts in-house. If you buy parts for your cars in the aftermarket, any team can have the same part and be competitive with it. So where’s the advantage to gain an edge? It’s by building your own parts to your own specifications. This can give you a lighter part, stronger part, one that won’t fail during a race. Or a certain quality that isn’t offered in the after market or a component that offers a design that enhances the car’s abilities for speed. However, this also constitutes a large investment in machinery and fabrication equipment as well as the talent to use the equipment.

“Advances in machine tool technology allow a short production lead time, more sophisticated parts, with a greater level of quality, and more precise parts than could ever be achieved before.”

In the relationship between new technology and racing, Miller said, “If you don’t push the sides out of the envelope everyday, your competitors will leave you on the bench. Right now the learning process is so accelerated in racing that any kind of technology relationship that you can develop, such as the one Penske has with Mazak (Florence, KY), is worth more than anything that a sponsor can give you in a cash type of sponsorship. Benefits that you get from a technology relationship can’t be bought.

“Let’s say we look at a specific engine component and we want to make it better. We can’t take the time to develop it by trial and error anymore. You have to go to a base of people who have the technology to build a better component, from materials to final processing. We have to rely on these people for manufacturing technology when we need it and help us to speed the process to build a component. For instance, we went from grinding valve seats in our engines that took us nine hours to cutting them in just 20 minutes.

“With Mazak’s machine tools we make very small intricate parts for our transmissions, differential gears, suspension parts and engine components. We used to buy these parts, but we felt that we could make them better in-house. We formed a partnership with Mazak for its technology. And now they’ll come up with ways to make the parts faster and better than what we can buy. And this gives us an edge in racing.

“Without our technology partners, everything was trial and error. What takes us three hours to do now, would have taken us three months before. And the gains that have been made for the engine, transmission and chassis components have been astronomical. For instance we hope to make our own crankshafts soon with the use of a Mazak Integrex.”

### **Making Crankshafts In-House**

Miller said, “to buy a crankshaft, we have to order one and give the supplier all the specifications such as stroke, side clearances, pin diameter, total weight and counter-weight

placement. Because everyone in racing is trying to do the same thing, and there are only three or four recognized crankshaft sources, it can take up to eight weeks to get one, and the wait starts to add up. Also if you get away from these vendors, the margin for error increases too much. So you want to stay with the vendors who know what they are doing and not risk any errors or failures.

“Sometimes we would wait six weeks and then the crank would be back ordered for another two weeks. During this time competitors who have new cranks are beating you. So we want to build crankshafts in-house. If I need a crank and I’ve got the raw materials, I can build one with a Mazak Integrex in eight hours, not eight weeks, which is phenomenal.”

Originally to develop a process to produce a crankshaft in just eight hours, Mazak partnered with a major automotive manufacturer. The information that was developed from this process can now be used for the production of racing crankshafts.

To develop a family of crankshafts for this automotive manufacturer, a project engineering team was formed at Mazak’s National Technology Center (NTC, Florence, KY) to study the crankshaft application and its ambitious goals. Martin Roderick was assigned to develop the machining logic and associated tool library while Neil Desrosiers looked after the man-machine interface in the Mazatrol PC Fusion CNC control.

Martin’s approach, rather than using the entire part as an engineering model, was to break the family of crankshafts down into relevant features (a pin journal, a counterweight, an oil hole, for example). This allowed each feature of four, six, eight and ten-cylinder crankshafts to be processed and “stacked up” in an intelligent machining program at the CNC operator’s panel. Rules-based programming was embedded in the CNC to ensure a “legal” sequence of main and pin journals, counterweights, etc. Among this family of crankshafts, changes in offsets and angles are manually input at the screen and a part program is automatically generated and executed.

Within the CNC control, each feature is linked to its own tool library. The number of tools and their dimensions are in a database to ensure that the design input is consistent with tooling reach, access and angular position to process the part. Should any tooling value be exceeded, the program will display a fault to fail-safe the tooling and machine at the programming stage.

Due to the machine tool's five axes movements and unique turret design, no special cutting tool configurations were needed.

Also within the Mazatrol Fusion CNC are stored process cycles (macros) including machinability and process parameters for each feature. Tool paths, speeds and feeds are automatically determined within these functions to offer optimum cutting conditions while protecting the machine tool and cutting tools. To introduce new configurations of crankshafts, the CNC allows identification of a new family along with associated processes, machinability and tool libraries to ensure ongoing expandability.

### **Choosing the machine tool**

Mazak embraces the single setup philosophy from raw material to finished parts whenever possible. This saves valuable time in part handling and provides higher accuracy since the part datums are fixed. Due to the complexity of crankshaft geometry's, there was only one choice for single setup operation, the Integrex family with B-axis.

Integrex 300Y multi-tasking machine is classified as a turn/mill machine tool. But, Mazak has taken the turn/mill philosophy to new levels with the more powerful milling capability in the Y and B axes. In addition, Integrex offers a C-axis for the main spindle rotation powered by a 3500 rpm, 35 HP motor. A Y-axis is incorporated for off-the-centerline travel with a distance of +/- 4.13" for milling, drilling and tapping. And a powerful 20HP, 6,000 rpm spindle is built in the single-pocket turret (live spindle) which rotates a total of 225° in the B axis to machine angled features in increments of .001 degree. The turret design allows one turning tool to be used for left and right hand operations by rotating the tool 180°. All of these motions were required to completely machine the rough crankshaft.

Acting more like a machining center, Integrex tools are held in a tool change magazine, regardless of whether they are fixed (for turning) or rotating (for milling, drilling or tapping). Tools are changed in 1.3 seconds and up to 80 can be stored. This extensive tool library played an important role in making the crankshaft application a success.