CNC MACHINING

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CAD/CAM FOR TOOLING WORK

IMTS 2000 WRAP–UP

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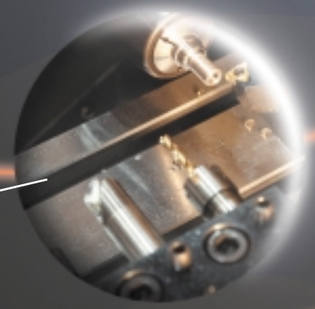

THE MASTHEAD

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by Alan Phillips, President of Phillips Corporation

Living Life on Purpose – with a great & worthy mission!

> "I have sworn upon the altar of God eternal hostility against every form of tyranny over the mind of Man."

As missions go, this one seems particularly ridiculous – eternal hostility – implying action beyond one's lifetime.

What do you make of Gene Haas' mission to create the biggest and best machine tool company in the world? Ten years ago, if someone asked me, I would have said that Gene Haas has no chance. I would have said that the mission to build the biggest and best machine tool company from ground zero is ridiculous – there are already many strong, well-positioned machine tool companies. Gene Haas could not really think this is possible.

Of course, we all have learned something about Gene and Haas Automation over the last ten years. We have learned to think about things differently, and ask different questions.

What does it mean to be the best? What is the criteria for measurement? Is it the best by any measure? Does it require the best leadership? Or does it require the best person in every role? Does it take the most elegant gears, the best specs or the boxiest ways? Does it take a disdain for mediocrity and a love of virtuosity? Does it take benevolence or ruthlessness, or maybe benevolent ruthlessness? Does it take being bold, taking big risks? Does it take a willingness to put your money where your mouth is, or does it take being laughed at? Does it take a particular culture, maybe even a community?

Our company is proud to be part of the Haas community. We feel it is a great one! We manufacture machine tools, the famous Haeger Press, and we are the owners of six Haas Factory Outlets. Being president of a machine tool company, I am most interested in what I can learn from Haas to make our company more successful. I often have the opportunity to be with Haas people. I am always peppering them with questions. How do you do this? Why did you do that? Why is the company so successful? What makes General Manager Denis Dupuis tick? How come the team has been together so long? Who does the product development? How is it done? How does Haas create, then keep up with, demand? What does Gene spend most of his time doing? Etc., etc.

We have benefited considerably from being Haas' partner – we have learned much from the association. We have watched as Haas has woven the threads of its community to include not only the people who work at Haas, but also many people throughout the world as the Haas Factory Outlets established a strong local community identity. Of course, the most important members of the Haas community are the machine operators, programmers, set-up people, managers and owners of the job shops and manufacturing facilities around the world.

Through our association with Haas, we have learned to consider what it means to be the best from a different perspective – from the customer's viewpoint. And we have learned that today's customer wants value and service. It is clear that Haas has learned how to provide this better than any other. A combination of great machines with guaranteed up time and local Haas Factory outlets with professional sales engineers, stocked service vans, and certified service engineers, along with the industry's most helpful website, has proven to be the winning combination. All of this has become part of the Haas community.

We have shops in our market with people who appreciate being part of the Haas community so much that we call them Haas zealots. WOW!

So, maybe the measure of being the best is having the greatest community. I don't know. I do know competence and commitment to a cause when I see it, and I have no doubt that Gene will accomplish his mission to become not only the biggest, but the best machine tool manufacturer in the world.

Oh, by the way, the mission at the top of this article belongs to Thomas Jefferson. Living not far from Washington, D.C., I often visit the marvelous sights there: the Smithsonian, the Capitol Building, the National Gallery of Art, the Lincoln Memorial, the Vietnam Memorial. One time while visiting the Jefferson Memorial the words engraved on the wall caught my attention.

More than 200 years later, Jefferson's Declaration of Independence continues to clear the way for man's freedom all over the world. Maybe having a mission which is eternal is not as ridiculous as it first seems. I wonder how long it will take Gene Haas to accomplish his mission? Given the successes of the Haas company, I would expect that he will still be alive and kicking when it becomes a reality.

Haas Automation Goes to Europe

On September 1, 2000, Haas Automation, Inc., established a new division to sell and service Haas products throughout continental Europe and the former Eastern Bloc countries. Dubbed Haas Automation Europe, the new division is based in Brussels, Belgium, and headed up by Managing Director Dr. Ing. Theo Leon. Haas will begin offering its products immediately in Germany, Spain, Portugal, Belgium and the Scandinavian countries, and will expand into other countries of Europe over the next three years.

"We are not going to achieve our goals overnight in Europe," stated Haas Automation President Gene Haas. "It will take three to five years or more to acquire the market share we believe is possible. But our European commitment and strategy are long-term. Our policy has always been to rely on volume sales rather than per-unit profit," Mr. Haas continued. "This approach, combined with high-tech innovations and rock-solid engineering, allows us to provide lower prices, more standard features and a better price-to-quality ratio than perhaps any other CNC machine tool builder in the world."

Dr. Ing. Theo Leon

Haas Automation Europe will offer Haas products at fixed end-user prices, in euros, across Europe, customs cleared (excluding transport cost). A multilingual factory-trained team based out of the Brussels headquarters will assure complete support for the customer. By year's end, a technical center fully equipped with demonstration, training, service and spare parts facilities will be opened near Stuttgart, Germany. Six additional technical centers are planned for other European sites in the future.

Haas will continue offering its products in the United

Please see EUROPE page 35

Haas Garners Awards

Gene Haas, president of Haas Automation, was selected for *American Machinist* magazine's Hall of Innovators for his achievements in looking beyond traditional approaches to manufacturing during the 1980s. Mr. Haas was presented with a plaque signifying the award during ceremonies at the Drake Hotel in Chicago September 5.

Mr. Haas was chosen as an innovator for his development of the Haas 5C collet indexer and the Haas VF-1 vertical machining center. The Haas 5C was – and still is – an easy-to-use and economical method for increasing productivity on manual mills and machining centers. The VF-1 provided an affordably priced, competitive VMC at a time when foreign competition was overshadowing U.S. production and sales.

Haas Automation also received *American Machinist's* 2000 Excellence in Manufacturing Technology Achievement Award for Design & Productivity.

Haas Automation Sells 25,000th CNC Machine at IMTS 2000

It was in 1988 that Haas Automation, Inc., introduced the company's first CNC machine at the International Machine Tool Show in Chicago. The affordable VF-1 caught the competition napping, and with a price less than $50,000, it established Haas as a manufacturer that pays attention to the customer's bottom line.

Now, just 12 years later, the 25,000th CNC machine has been sold at IMTS 2000. The machine that garnered this recognition is one of the company's versatile VF-0E vertical machining centers. A special plaque commemorating the event was presented to the new owner, Chuck Thudium, president of AT Precision of Northbrook, IL, at this year's show in Chicago. The finished machine was delivered to AT Precision by the Chicago Haas Factory Outlet (a division of Arthur Machinery, Inc.), where it joins 12 other Haas VF-0Es in the production of a wide variety of products.

It took Haas less than 10 years to manufacture its first 10,000 CNC machining centers and lathes – an impressive feat in itself. The company's state-of-the-art manufacturing facility

Please see 25,000 page 35

> RACE REPORT

The turning leaves of autumn are a prime indicator that the time for some serious racing is at hand. With the onset of October comes the end of the motorsports season, and the final push for championship points. But before you settle in for a winter of football and hockey, we've got some Haas milestones to celebrate!

While Haas has visited the NASCAR winner's circle often – thanks to the hard-charging efforts of the Hendrick Motorsports team – victory in open-wheel competition has been elusive . . . until now. The Chicago CART race found the Haas-sponsored car of Cristiano da Matta taking the checkered flag and beating out veteran charger Michael Andretti. This hard-fought battle marks the first CART victory for a Haas-sponsored car. The finish had the crowd on its feet and screaming as the PPI Motorsports car crossed the line with Andretti a mere 1.4 seconds behind.

In a racing series where the entire field can qualify with lap times within 1.5 seconds of each other, this kind of competition can't be beat. Cristiano's Pioneer Toyota/Reynard uses parts cut on PPI's many Haas CNC machining and turning centers. He also plays a Fender Custom Shop Stratocaster, cut on a Haas VF-4, natch. Our congrats to Cristiano and the crew at PPI Motorsports.

PacWest Racing Group driver Scott Dixon continues his winning ways in this year's Indy Lights competition. Leading the series, Dixon is slated to take over Mark Blundell's Champ car seat for the 2001 season. Blundell is leaving the PacWest team and will become a free agent. Mark, who started with PacWest in 1996 following a stint in Formula One, has posted a number of wins for the team. If Scott Dixon's Indy Lights talents carry over to the big series, we can expect to see his name listed soon in the CART Champ car record books.

In related competition, PPI drivers Andrew Bordin and Dan Wheldon are dominating the Formula Atlantic field and taking turns standing on the winner's podium at the end of the race. It's not uncommon for both team members to finish in the top three, pushing the Haas-stickered nose across the finish line in a very winning way.

Overall wins aside, the Haas association with the racing fraternity illustrates the close relationship between precision driving and precision machining centers. This fact leads to interesting discussions when Haas sales representatives bring prospective clients into the racing facilities where they can see Haas CNC machining centers making the parts that win races.

Scott Dixon, currently leading the CART Indy Lights points championship, has earned a seat in a PacWest Champ car for the 2001 season.

PPI Driver Cristiano da Matta drove his Toyota-powered Reynard to victory in Chicago, giving Haas its first win in the hard-fought international CART series.

Hendrick Motorsports

WINSTON CUP SERIES

The Winston Cup championship title is still a crapshoot, with most everyone in the top ten still playing around with three or four wins each. However, it's the top ten finishes that are racking up the points. Jeff Gordon (#24) is still fighting it out in 10th overall, with three wins and fifteen top tens. Teammate Terry Labonte (#5) suffered from an inner ear problem that broke his "Ironman" streak at 655 consecutive race starts, but he's back in the game. It seems the final cure involved some non-stop roller-coaster riding as a test.

Jerry Nadeau, still the new whiz kid for the 2000 season, has kept the #25 Hendrick entry either up front or leading the majority of the first 25 races. He looks ready to pick up his first win before season's end, so keep an eye on this car!

CRAFTSMAN TRUCK SERIES

Jack Sprague (#24), driver of the Chevrolet Silverado pickup entry from Hendrick Motorsports, is fighting with the Fords and Dodges to maintain his present ranking of fifth in the point standings. Even with a season full of hard crashes, Sprague has still finished in the top five in more than half of the races run so far and is running second in overall wins.

PacWest Racing Group

CART CHAMP CARS

Mauricio Gugelmin worked his way up to second place at the snow-delayed Nazareth race, giving PacWest its first podium finish for the 2000 series. Mechanical maladies and off-course excursions continue to plague the team, but the points are racking up, and the two cars will be starring in the new Sylvester Stallone movie on the CART racing series, "The Champs." In fact, "Sly" will be wearing "Big Mo" Gugelmin's racing suit. Watch for the Haas logo in this gala tribute to auto racing – it should be everywhere!

CART INDY LIGHTS

As noted above, new PacWest driver Scott Dixon is leading the pack in the competitive Indy Lights series with teammate Tony Renna also running high in the point standings.

All American Racers (AAR)

ATLANTIC SERIES

AAR may have pulled out of CART Champ car competition for the 2000 season, but the Gurney name is still on course and keeping an eagle eye focused on the checkered flag. This driving force is none other than Dan Gurney's son, Alex.

Running the #48 Swift 008.a (a car built by Swift Engineering in San Clemente, Calif., with parts machined on Haas CNC machining centers), Alex has already earned one Kool/Toyota Atlantic podium finish in Trois-Rivieres, PEI, Canada, where he enjoyed the champagne ritual that his father made a racing tradition following his win at Le Mans. Future goals are said to include a Formula One ride at Indy. It could easily happen, considering his family history.

PPI Motorsports

CART CHAMP CARS

As noted in the opening of the Race Report, Cristiano da Matta is the first CART driver to carry the Haas Automation logo into the winner's circle, and he did so at Chicago's new oval. Well up in the top-ten point standings, Cristiano and his teammate Oriol Servia are pushing their Toyota-powered Reynards hard, trying to earn more points. Servia is also in the top three for Rookie-of-the-Year honors.

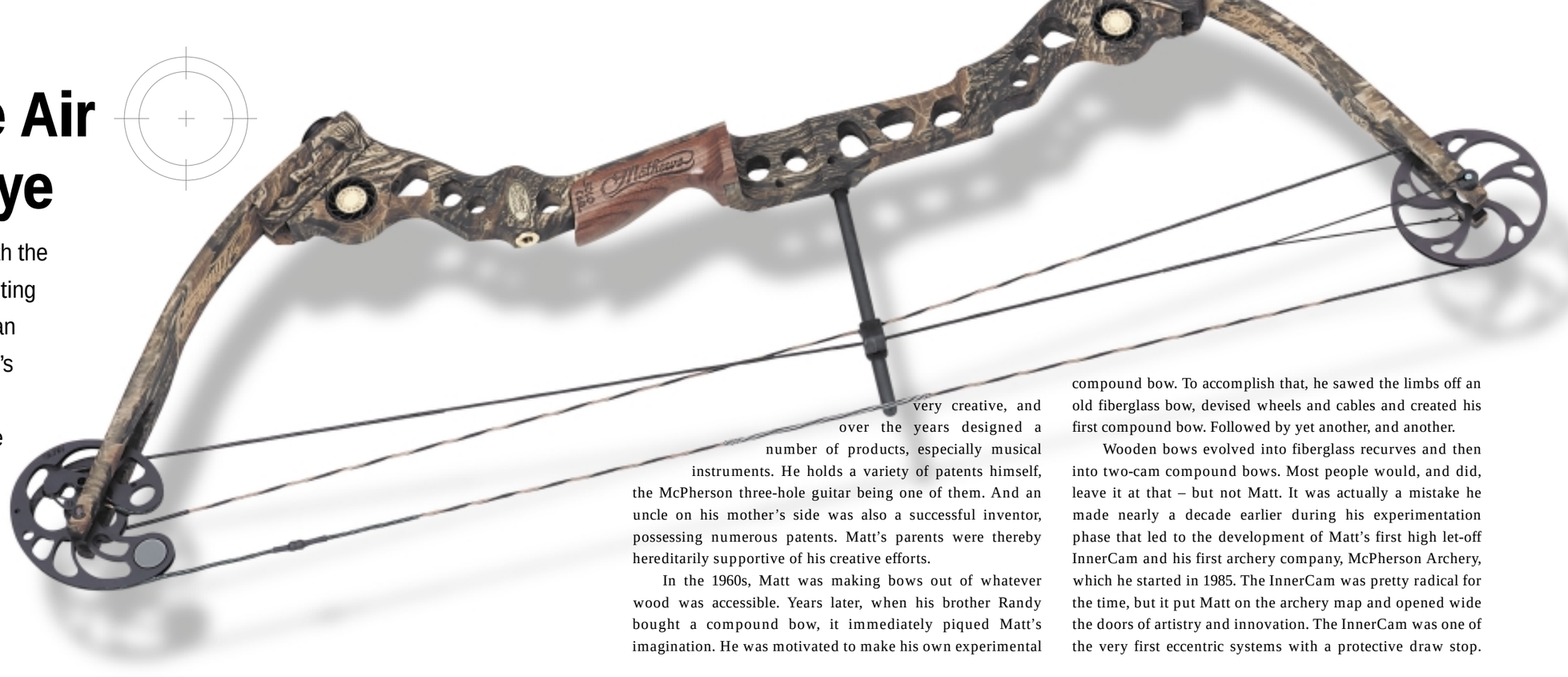
ATLANTIC SERIES

Additional good news at PPI is the performance of the Kool/Toyota Atlantic series team, with Andrew Bordin and Dan Wheldon battling each other for first place in the championship. The team has a reputation to uphold – last year it finished first and third in the series.

Arrow in the Air Hits Bull's-Eye

Story
Olaf Wolff

Photos
Scott Rathburn



Imagine looking at a wheel with the full-blown intention of reinventing it. To say that intent requires an unimaginably brazen faith in one's creativity would be a definitive understatement. It would also be an accurate portrait of Matt McPherson, the brains behind Mathews Archery.

Matt has accomplished the relative equivalent of reinventing the wheel – and much more. In a mere eight years he has taken his small, upstart bow company and positioned it right smack at the top, winning every Men's Pro event in every professional circuit. Last year alone, pro shooters using Mathews gear claimed 15 of the 21 Men's Pro titles. For the first time ever an archery company made the *Inc.* magazine list of the 500 fastest growing privately owned companies in America – not once, but two years in a row. And Mathews currently stands as *Inc.*'s highest-rated outdoor company ever.

Mathews needs to introduce new models each year just to stay a step ahead. There are probably no more than 24 bow companies in existence, most of them small, yet this is a highly competitive business. What competitors are doing this year, Mathews was doing a year or two ago, and in some cases even earlier. Matt continues to be the creative driving force – in essence, being the hunter, not the hunted. A self-taught engineer and a seat-of-the-pants kind of guy, his unassuming explanation is, "I've always felt compelled to make things." He tests the prototypes and gives the final go-ahead on all projects. He is an entrepreneur in the purest sense, and that's just the way everyone likes it.

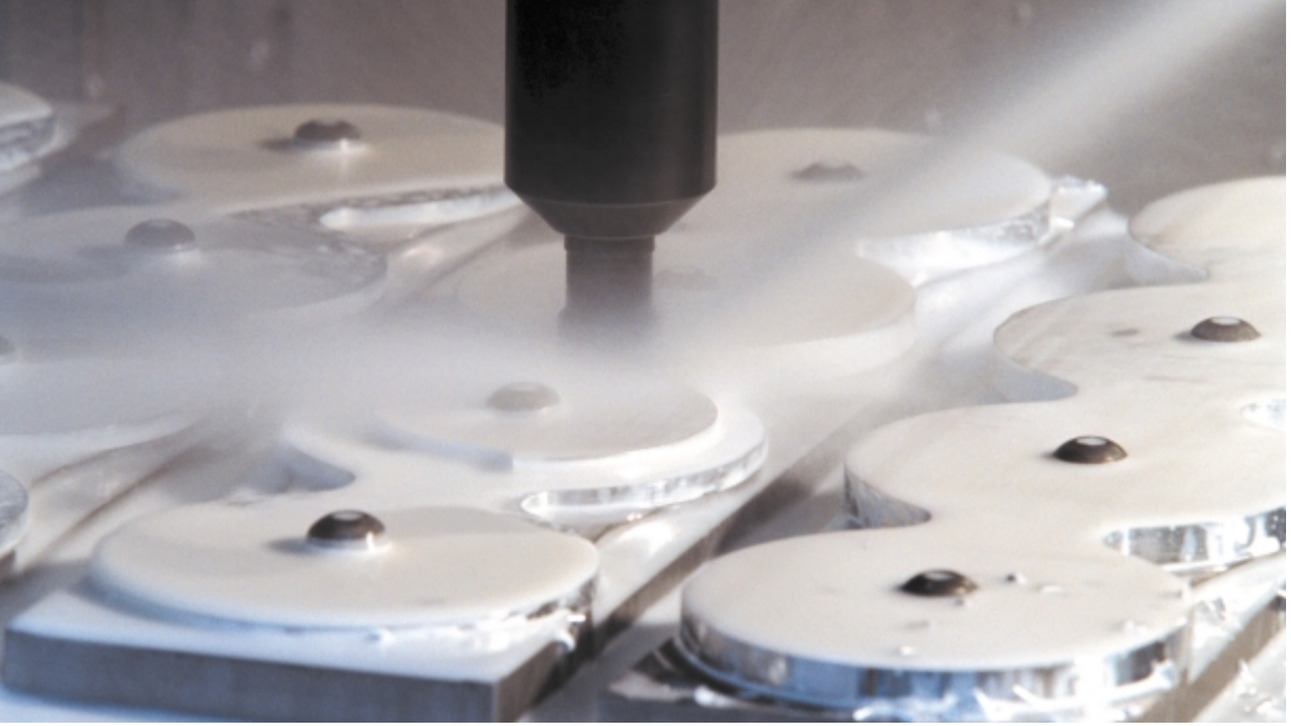
From the time Matt was a young boy his insatiable curiosity had him taking things apart, but, unlike most of us, he could generally reassemble them. In the words of Mike Ziebell, Mathews Marketing Director, "He just always has that touch." According to Mike, Matt still has quite a few secrets up his sleeve to keep the company at the forefront with something new each year. Matt believes if you introduce things a step at a time, people are going to appreciate that they work, and therefore be more likely to make a purchase.

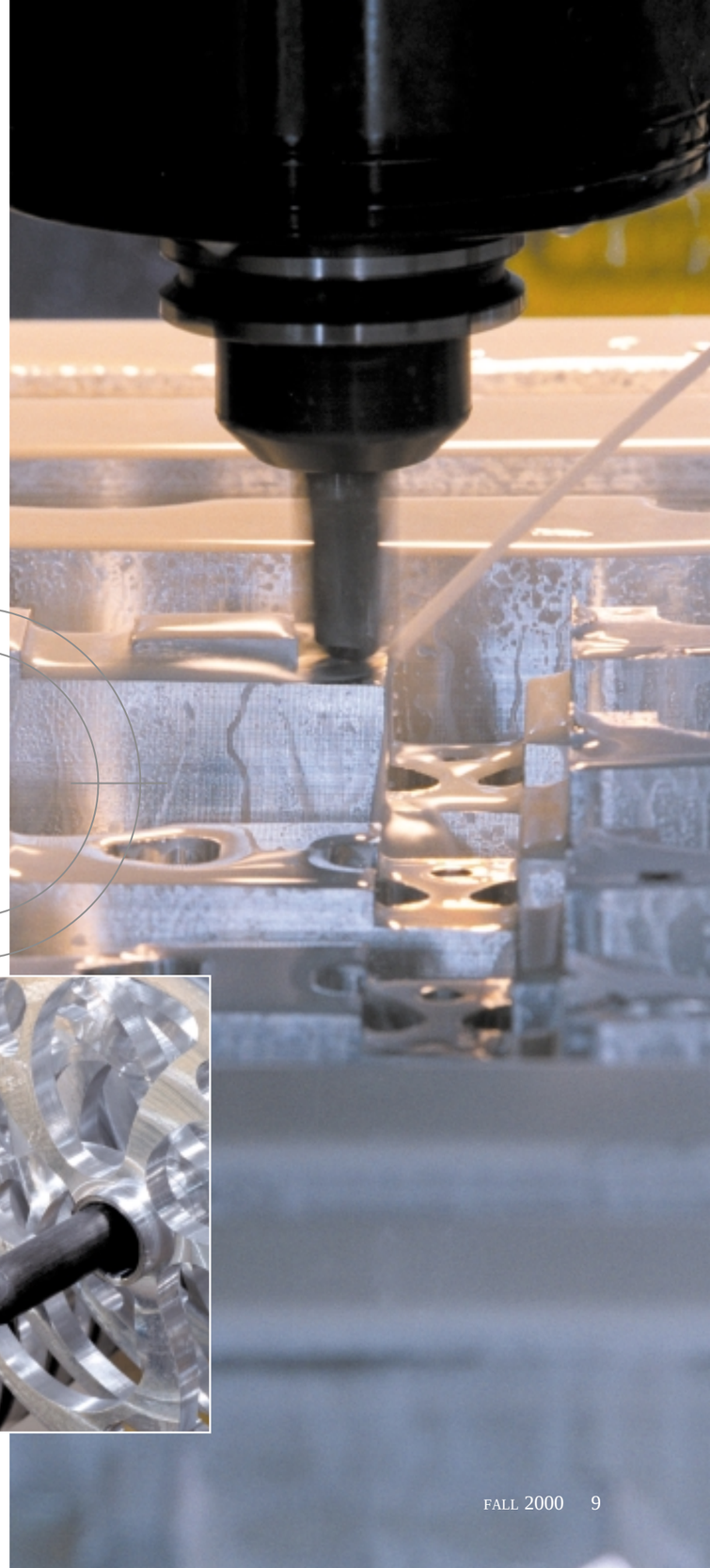
Okay, maybe Matt didn't actually sit down with the intention of reinventing the bow; perhaps it was more of an accidental evolution of sorts, but the creative seeds for such an undertaking were planted long ago. Matt and his brothers were introduced to the sport at a very early age by their father. They'd tag along with him when he bowhunted, carrying their fiberglass recurve bows. The story told is that their dad wanted to go deer hunting, but Mom didn't want the brothers to go with guns because of the chance of getting hurt, so Dad agreed to go with a bow. Things followed an apparently predestined course from there on.

Matt's parents' contribution to the whole of his accomplishments goes far beyond merely inspiring the use of bows, though. There also is a clear and traceable hereditary influence from both sides. His father was very creative, and over the years designed a number of products, especially musical instruments. He holds a variety of patents himself, the McPherson three-hole guitar being one of them. And an uncle on his mother's side was also a successful inventor, possessing numerous patents. Matt's parents were thereby hereditarily supportive of his creative efforts.

In the 1960s, Matt was making bows out of whatever wood was accessible. Years later, when his brother Randy bought a compound bow, it immediately piqued Matt's imagination. He was motivated to make his own experimental compound bow. To accomplish that, he sawed the limbs off an old fiberglass bow, devised wheels and cables and created his first compound bow. Followed by yet another, and another.

Wooden bows evolved into fiberglass recurves and then into two-cam compound bows. Most people would, and did, leave it at that – but not Matt. It was actually a mistake he made nearly a decade earlier during his experimentation phase that led to the development of Matt's first high let-off InnerCam and his first archery company, McPherson Archery, which he started in 1985. The InnerCam was pretty radical for the time, but it put Matt on the archery map and opened wide the doors of artistry and innovation. The InnerCam was one of the very first eccentric systems with a protective draw stop.





". . . the machines have helped, because we can do a lot more in-house. So we haven't been as dependent on the suppliers."

Mike Ziebell – Mathews Marketing Director

The major components of a Mathews bow, including the idler wheels (above) and risers (far right) are machined from aluminum billet. Multiple fixturing allows Mathews to get finished parts off the machines every time the doors open.

Today, of course, all this seems perfectly normal and desirable, but back then it was a somewhat radical, and evidently scary, idea.

To start his first bow company, Matt had taken on two investors. Their money funded the company, but their conservative views on marketing and promotions also nearly extinguished it. Without the capital to properly fund his ideas, the business went almost nowhere. Three years later, frustrated, he sold his shares in McPherson Archery.

That introductory experience only served to make Matt more determined. Being a man of faith, and believing that all things happen for a purpose, he took comfort in the belief that his first archery company was a learning experience – and if nothing else, a lesson in marketing. The degree of success he'd experienced with the InnerCam inspired him to develop the next step in cam evolution. Two-cam bows, including Matt's own design, had long shared a common problem: accurate synchronization of the rollover of the two cams. As occasionally happens, the solution came to Matt during the solitude of driving. His initial thought at that instant was, "Can this really be that simple?" His conception involved a simple solution to the common problem. He envisioned a system in which cam synchronization was eliminated.

Matt drove straight home and created a prototype – and the inspirational vision he'd experienced in his car worked. That was in 1991, and the SoloCam breakthrough earned Mathews the single-cam patent and was the beginning of Mathews Archery. "I knew, deep down, that the SoloCam had the potential to change archery," is the way he puts it.

That again is a prime example of understatement; today, most manufacturers offer single-cam models. Estimates project single-cam sales to be nearly two-thirds of the entire compound bow market. Of all the hunting, fishing, camping and outdoor products on the market, *Field & Stream* has awarded "Best-of-Best" distinction to only 15 products, and the Mathews MQ-32 bow (an evolution of the original SoloCam bow idea) is one.

In January of 1998, Mathews purchased its first two Haas VF-4s. Prior to that, most of the company's machining was outsourced. A friend of Matt's used Haas machines and had enthusiastically endorsed them. Scott Jenkins, the machine shop foreman, and Matt were both thoroughly pleased with the immediate performance of their Haas machines, encouraging them to make more machine acquisitions. "They're affordable," says Scott, "and they've kept coming down in price ever since we've been buying them. Usually things go in the other direction – they go up." Since that initial purchase a scant two years ago, Mathews has installed an additional eight Haas vertical machining centers. In the works at the company's Sparta, Wisconsin, facility is another 20,000-square-foot building devoted primarily to the machine shop. The number of Haas machines

employed could very well jump to 25 within the next couple of years.

In the making of a Mathews bow, essentially the riser (the main handle), the limb cups (which secure the limbs in position), the cam (on the bottom) and the idler wheel (on the top) – everything, in fact, except the fiberglass limbs and the wooden grips – are all machined on Haas equipment. When asked if there's a concerted effort to bring as much as possible in-house, Scott's answer is, "Yeah, it always helps. But I don't know if we'd ever want to be totally self-sufficient. It's always nice to have someone to fall back on. Say we had a power outage or something, and blew out a bunch of machines. It would be three days or more before we got back running. How would we ever pick back up, especially with the tight schedule we keep?"

At Mathews, machining operations exclusively involve aluminum. Most bows are made of 6061, except the Safari model, which is 7075. A typical riser starts as a 2" x 4" x 27" piece of aluminum. The first operation drills and taps a couple of holes, which are then used to mount the pieces for the next operation. Then they mill one half at a time, typically running three- or four-up, depending on which model and how many will fit on the machine. When asked why they don't simply batch each operation, Scott replies "It's nice that every time the door opens, you've got a finished part. It also keeps a more even flow than batching parts."

For Scott, getting the model from the computer-aided manufacturing design to the machine is pretty much a no-brainer. "I've done it enough times where I can usually nail it pretty much on the first one or two pieces," he remarks. He adds, "I actually had a guy in the other day, he was out here for a couple of days, a few hours back and forth, and by Friday he was doing parts on the machine. You just kind of pick it up – like anything, the farther you go down the road and the more you use it, the more familiar you get with it." At this point only the editing is done at the machine. "Haas has probably got one of the most user-friendly controls I've ever seen. It's easier to edit programs there than to do it on the computer," comments Scott. He goes on to explain that the control is so easy to learn that all the operators rotate daily in order to get familiar with each machine and each operation. That way anyone can fill in for another operator.

By all accounts, productivity has risen with each new Haas machine, and Haas machines have helped Mathews stay that necessary step ahead. It all goes back to prototyping and keeping most functions in-house. If something doesn't work, they know about it the same day and change it.

Matt McPherson doesn't plan to slow his highly creative life down anytime soon. His priorities have long been in order: God, his family, himself and his work. With faith and family as his foundation, he's securely grounded, providing him with the clarity to keep several irons in the proverbial fire. "But without my incredible staff of employees," Matt emphasizes, "none of this would be possible."

Along with Mathews Archery and its separate Zebra Bowstring division, Matt is revitalizing McPherson Guitars with the introduction of an iconoclastic new acoustic guitar. Plus there's Justin Charles, his company named after his middle son that specializes in high-tech sleeping bags and fly rods. And, just to balance these out, there's Autumn Records, Matt's own gospel recording label, for which he and his wife Sherry record gospel CDs – which returns him full circle to his number one priority.

Considering that Matt continually travels at the speed of creativity, don't be surprised if he does indeed uncover a more effective way of rolling the wheel.

Mathews
608-269-2728

The Mathews facility is being expanded by an additional 20,000 square feet, most of which will be devoted to the machine shop. The number of Haas machines the company uses to manufacture their bows could jump to as many as 25 over the next few years.

Haas Excellence Underscores CMTSE Commitment

Story
Greg
Safko

Photos
Scott
Rathburn

No one has to remind the U.S. machine tool industry of the competitive pressures in today's markets, or the importance of building and establishing good relations with customers. Rapid changes in machine tool technology, combined with the growing sophistication of computerized equipment and the ability of machines to perform multiple tasks, have created new challenges for both the manufacturer and the distributor.

Today's machine tool buyer is more sophisticated and educated than in years past, demanding not only more from the equipment, but more from the distributor. If machine tool manufacturers and distributors want to continue "making the sale," they must provide customers with the equipment, the knowledge and the service they demand, or lose the sale to someone else.

Haas Automation is taking active steps to meet these new challenges and provide customers with affordable and effective manufacturing solutions. One step is the development of a nation-wide network of independently owned and operated Haas Factory Outlets (HFOs) dedicated exclusively to the sales, service and support of Haas products. Another step is the company's commitment to the Certified Machine Tools Sales Engineer (CMTSE) program sponsored by the American Machine Tool Distributors' Association (AMTDA). This program ensures that every Haas sales engineer has the education, skills and support necessary to address customer needs.

Certified Machine Tool Sales Engineers have a proven level of knowledge in machine tool technology, sales and administration skills. Dave Hayes, above, a CMTSE and product manager for Haas Automation, talks with a delegation from Washington, D.C., at IMTS 2000.

The CMTSE program currently reflects the participation of more than 1,000 individuals and 200 machine tool builder and distributor companies. Introduced in 1993, the program was developed in response to surveys showing that customers perceived a need for better sales and technical expertise by machine tool sales engineers. In some cases the perception was so strong as to seriously limit sales potential.

The process of certification begins with real machine-tool sales experience. Only sales engineers with four years of related machine-tool employment or two years of related employment plus a four-year college degree can register for the CMTSE program. Once a sales engineer is registered, the AMTDA provides a comprehensive two-volume Candidate Study Guide that addresses multi-disciplinary topics covered in the CMTSE examination. The study guide includes references for further study on particular subjects, and for each section reviews exam goals, key terms, subject matter, recommended reading and sample questions.

The study guides are based on the concept that all aspects of selling must focus on determining, meeting and satisfying customers' needs. A recently revised sales engineer job analysis was developed by a joint AMTDA/AMT (The Association for Manufacturing Technology) task force and refined by subsequent regional work groups and a national validation study. AMTDA's Certification Committee adopted this job analysis to serve as the revised foundation for future examinations and study guide development. Both the study guides and the new sales engineer job analysis serve as an invaluable framework for further company training programs. The end result is not only better training for individuals, but also much more comprehensive company training.

The CMTSE examination itself consists of 150 multiple-choice questions given over three hours. The broad-based test covers many areas of sales administration and machine tool technology. Legal and ethical issues, technical terminology, analytical techniques, time management and even financial justification topics are among the questions covered in the examination. Participants must pass 70% of the questions to achieve Certified Machine Tool Sales Engineer status. Those who pass the exam gain the right to use the CMTSE logo after their name and are recognized throughout the industry. Additional benefits include the knowledge and expertise gained during the study and examination process, the self-satisfaction of the accomplishment, respect and recognition by colleagues in the industry and more open doors as customers recognize the value of working with CMTSEs.

According to David Hayes, Product Manager with Haas Automation and a member of the AMTDA Certification Committee, "While the examination may be the focal point of certification, it is but one step in a process that begins with potential CMTSEs broadening their experience and studying a wide range of subjects. Our customers benefit from the CMTSE program because certified sales engineers have a proven level of knowledge in machine tool technology, sales and administration skills."

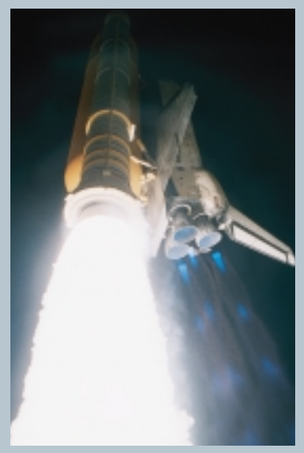
Now that participants have had some time to use their new skills and knowledge, many report that the certification program has yielded some unexpected benefits. "I think it's a good exercise for salesmen to go through, especially the newer guys to the industry," says Bob Arthur, President of the Haas Factory Outlet in Elk Grove, Ill. "It's absolutely not a waste of time. I think any learning experience is always beneficial. In the customer's mind, they're perhaps going to be a little more comfortable with a salesman who's become certified – they're more likely to continue the relationship."

Arthur points out, "The market and the customer are much more educated than in years past. We, as salespeople, have educated them. What it boils down to is that the salesman has to be more professional, more on his game. It's tough to be all things to all people, but you have to be better at what you do. Customers expect more from you and have less tolerance for ignorance. Business is tough out there, and your competitors are better because they're educated – or they're no

Please see CMTSE page 34

STILL . . . THE

FINAL FRONTIER



BY OLAF WOLFF

All shuttle photos courtesy NASA

There are entire generations that remember exactly where they were on July 20, 1969, recalling in sketchy detail the apprehension of waiting for those first grainy television images beamed back from the Sea of Tranquillity, live from the moon. And the accompanying child-like look of astonishment on adult faces, as though they were universally witnessing a miracle. Man walking on the moon: the stuff of childhood fantasies. The moon, inspiring poets, encouraging dreamers and soothing lovers throughout history, was on this day the source of our first out-of-planet television experience, starring real live American heroes, who proclaimed a single line of dialogue that shall live forever – "The Eagle has landed."

These same generations have permanently etched on their minds exactly what they were doing November 22, 1963, when they heard the news that John F. Kennedy had been assassinated. And we shall never forget January 28, 1986, the day the space shuttle Challenger alarmingly ripped us back to the reality of the extreme danger and total lack of tolerance for error there is when hurtling human beings into space atop an armory of high explosives.

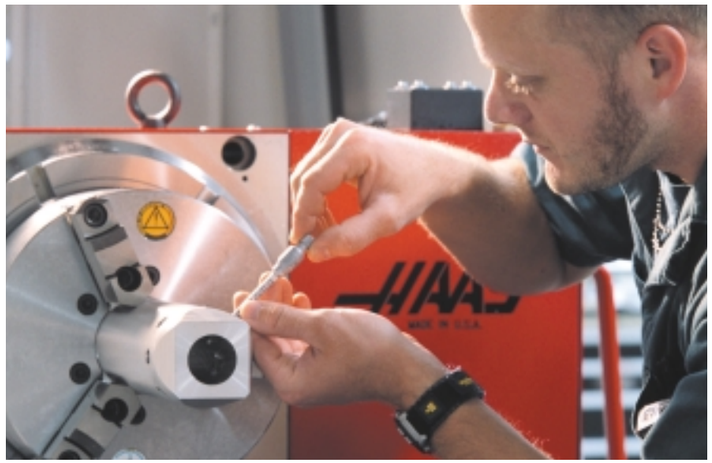
". . . this generation does not intend to founder in the backwash of the coming age of space. We mean to be a part of it – we mean to lead it."

President John Fitzgerald Kennedy
September 12, 1962

On October 7, 1958, six days after the National Aeronautics and Space Administration (NASA) was formally organized, the infant agency initiated Project Mercury, America's first human space flight program. A mere three years later, in 1961, as Alan Sheppard was drying off from landing in the Atlantic ocean following his sub-orbital flight, President John F. Kennedy committed America to being the first to set foot on the moon.

Shortly after JFK announced his bold plans to a mesmerized country, Congress approved development of a sandy stretch of marsh and scrub 34 miles long and 10 miles wide on Florida's east coast, midway between Jacksonville and Miami. The "Space Coast" had long been determined ideal for launches and landings (since 1947, the Port of Cape Canaveral had been the chief launch site for long-range test missiles). Virtually uninhabited, the area enabled personnel to inspect, fuel and launch missiles without danger to nearby communities. The area's climate also permitted year-round operations, and rockets could be launched over water instead of populated areas. This despite being positioned in an area with one of the highest frequencies of lightning strikes in the world, averaging more than 1,000 cloud-to-ground strikes per month during the summer. The extreme weather presented yet another pragmatic challenge for NASA to overcome.

NASA's Marshall Center (located in Hunstville, Alabama) was inevitably presented with the significantly greater challenge of developing the family of immense rockets that would eventually take us to our predestined lunar rendezvous. To this day, Marshall Space Flight Center is the leader in the development of advanced earth-to-orbit space propulsion systems and technologies.



THE DEVELOPMENT INTEGRATION LABORATORY'S MACHINIST/ PROGRAMMERS PRIDE THEMSELVES ON BEING METICULOUS. REPEATED TOLERANCE TESTING IS COMMON.

Concurrently, NASA's Launch Operations Directorate located at Cape Canaveral's Space Coast, an element of the then newly formed Marshall Space Flight Center, was elevated to independent status in July 1962 and renamed the Launch Operations Center. It was re-christened the John F. Kennedy Space Center (KSC) in November 1963, in honor of the slain president.

The Saturn rockets developed at Marshall to support the Apollo program, and to honor President Kennedy's pledge, were, at the time, the most powerful space launch vehicles yet built. It was a Marshall Saturn rocket that first took us around the moon, and then to its cratered surface.

The inventive Marshall team also perfected America's first space station – Skylab. The Skylab module was successfully positioned in orbit early on May 14, 1973. This particular event marked a major transition in the history of rocketry. Up until Skylab, the rocket had been the star – the main attraction. Skylab in essence stole the show. For the first time, space became a place in which to live and work. Flying aboard a rocket became secondary to the work being done once Skylab had been reached. The rocket became the earthside equivalent of commuting to work.

On July 15, 1975, a Marshall-developed Saturn I-B carried aloft America's half of the first U.S.-Soviet joint space endeavor – the Apollo-Soyuz project. After Apollo, the team at Marshall tackled the next worthy challenge, designing a revolutionary national space transportation system which came to be known simply as "The Space Shuttle."

The shuttle's main engines are among the most powerful and sophisticated devices ever created by man. They represent a quantum leap in technology above the engines which powered the Saturn V. Each of the three main engines of the shuttle provide nearly a half-million pounds of thrust, equaling the thrust produced by all eight of the Saturn I's first-stage engines. And these are the first reusable engines, capable of burning for up to 7.5 hours total. The thrust-to-weight ratio of these massive engines is the best in the world – each weighs a relatively svelte 7,000 pounds, yet puts out a staggering amount of power equivalent to seven Hoover Dams.

“MAN MUST RISE ABOVE THE EARTH –
TO THE TOP OF THE ATMOSPHERE
AND BEYOND – FOR ONLY THUS WILL
HE FULLY UNDERSTAND THE
WORLD IN WHICH HE LIVES.”

SOCRATES 500 B.C.

Twenty-four successful launches of the space shuttle lulled our collective consciousness into a false sense of complacency. Viewing them from the comfort of our homes, the launches became routine, ho-hum events – until the Challenger disaster.

January 28, 1986, the skies were clear and the sun shone brightly on an uncharacteristically cold morning at Kennedy Space Center. This was to be the 25th shuttle into space: Mission 51-L, the 10th flight of the orbiter Challenger. This launch, ironically, was one of the most publicized of the recent launches, because it was the first time that a civilian, a schoolteacher named Sharon Christa McAuliffe, was headed for space. This day was the coldest that NASA had ever launched a shuttle. At 11:38 a.m. Eastern standard time, Challenger left Pad 39A. Seventy-three seconds into flight, the orbiter Challenger exploded, killing all seven of its crew.

"Greater love has no one than this, that he lay down his life for his friends."

John 15:13

Several teams of experts were organized to find and fix the problem that had led to the accident. Investigations almost immediately focused on a defective joint in the space shuttle's solid rocket engines. Propulsion experts devised a number of modifications to the solid rocket design to remedy the fault. The disaster-enforced hiatus in shuttle operations gave Marshall – and other NASA installations – an opportunity to address other shuttle-related concerns. Major advances were made to enhance the reliability and safety of the turbine blades and turbo pumps in the shuttle's main engines. An escape system was implemented for the shuttle crew during leveled flight and improvements were made to the orbiters' landing gear and brakes.

On September 29, 1988, the shuttle program returned to flight with the launch of STS-26R, the orbiter Discovery. But nearly everything about how Kennedy Space Center operated changed after the Challenger accident. The number of overtime hours allowed was limited in order to reduce worker fatigue, further decreasing any chance of error. Even greater quality control checks were put into operation. And if individual workers took their jobs seriously before, a new intensity unrivaled anywhere was now uniformly experienced.

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And so it was, with this heavy fragment of space history categorically imprinted on my brain, that I flew to central Florida, in quest of what contribution CNC machine tools play in today's space program. In particular, the role American-made Haas machines play in building the space shuttle and the next generation of space vehicles. The fact that it was August, the hottest time of the year – and that a hurricane was on a collision course with exactly where I was headed – wasn't missed by me. What greater contribution could there be, after all, than to be destroyed in the line of duty. It was a commendable rationalization, albeit a bit extreme.

At 8:45, when the plane touched earth, there was some slight drizzle, but the pilot assured us, with some degree of confidence, that hurricane Debbie had wimped out and wouldn't be a threat. Good news for a Californian more attuned to quaking ground than cyclonic winds and ocean surges. The only challenge left now was to fetch a car and find my hotel room at Cocoa Beach. I could better deal with the stark reality of Florida's oppressive humidity after a decent night's sleep. For now, I chose to ignore it.

At Kennedy Space Center there are three individual contractors employing Haas machines in the creation and continuing replication of highly technical parts. The unique aspect of these operations is that it is one of those rare applications in which the inherent speed of Haas machines is not paramount. Far more crucial is the ease of setup and operation, as well as machine accuracy. This latter bit of information was one of the first discoveries I made visiting the initial NASA contractor the next morning.

THESE ARE RARE APPLICATIONS IN WHICH THE SPEED OF HAAS MACHINES ISN'T PARAMOUNT. MORE CRUCIAL IS THE EASE OF SETUP, OPERATION AND ACCURACY.

It occurred to me during the flight that in an age of instant Internet millionaires and microchip-generated special effects, it's easy to take for granted the intense level of competency required in every aspect of the space program. In this reality, fantasies and dreams don't successfully launch rockets – mathematics, metal machining and sweat do. To play a part, any part, in the continuing function of the space shuttle program – in the umbilical support systems (ground support for launch pad systems), and in the testing and development of the next generation of spacecraft, the X-33/VentureStar program – would be an admirable accomplishment for anyone involved. One that this journey would soon, I hoped, define. But first, there was a successful landing of my own to be made.

"United Space Alliance (USA) is NASA's contractor for operating the space shuttle," explained Jesse Harris, shop manager of USA. "We have two divisions: one in Houston which supports flight, and this one, which operates the ground support. Whenever the space shuttle comes back from a mission, it lands, they deconfigure it, take out all the things that were there for that particular mission, reconfigure it for the next time and launch it. What we do here is support that effort. We also support a lot of expendable components," he continued. "Many umbilical support components get destroyed during launch, and we constantly remake those parts and reinstall them.

"This particular shop has been heavily involved with the shuttle for more than 25 years. Anything we do affects them [the astronauts] – not only the mission, but their lives. About 75% of the people here now were outside watching when the Challenger exploded. It affected all of our lives greatly," Jesse commented hesitantly.

USA is currently using two VF-3 vertical machining centers, a single VF-7 and an SL-30 Big Bore lathe. They have also just installed a new large HS-3R horizontal machining center.

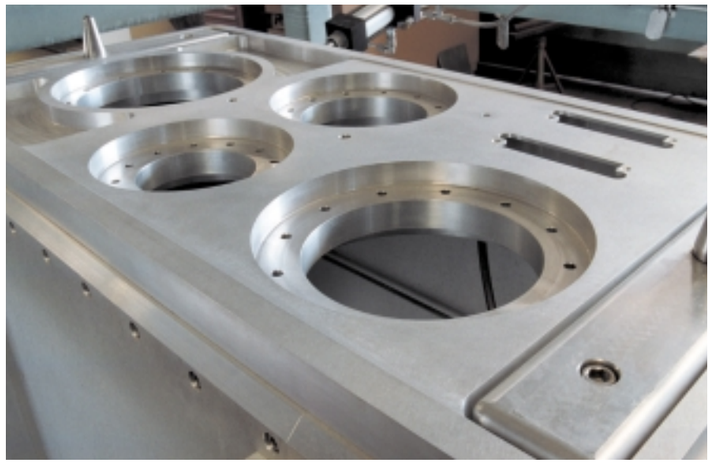
One of the unique features of the Haas control is that it is the same on all machines, allowing operators to move easily between mills and lathes. "As far as buttons and positions," explains USA machinist Steve Jezowski, "it's all the same. Everything is laid out the same on all the controls."

It's not uncommon for USA's CNC machines to run all day – 10 hours if need be. Much of the programming is done off-line, but not all. "We use Quick Code for the threading and other stuff," says Steve, "and I use G code for some of the roughing. I've programmed the machine by hand on purpose, just to get a feel for it."

My next stop was the Development Integration Laboratory (DIL), headed by John Poppert and his right-hand man Rusty McAmis. The DIL is responsible for creating test parts for stress analysis or eccentric/load analysis of umbilical components. They also use three Haas machines, a VF-5 for umbilical alignment pins, a 1994 model VF-3 (which they say works perfectly) to create eccentric coupons (umbilical test parts) and an HL-4, currently milling Delta-4 rocket cable guides (also a part of an umbilical system). All the guys at DIL pride themselves on being machinist/programmers, very proficient and meticulous in every aspect of their day-to-day work.

One of the most inspiring pieces of experimentation being done at the Development Integration Lab is the X-33 Rise Umbilical test stand, a device used to test simulated pre-launch connections and launch disconnects of the X-33 reusable launch vehicle.

The alignment pins, which are machined from 6061 T-6 aluminum on a Haas VF-5, align the electrical and hydrogen/oxygen connectors during automated pre-launch operations. The four large openings in the test stand are mounting surfaces for liquid disconnects. One is for oxygen, one is for hydrogen and the others are for gaseous nitrogen purge lines. There are also two rectangular openings for electrical disconnects. The bottom portion of the test stand simulates GSE (ground support equipment), a section of the launch pad that disconnects from the orbiter. The top piece simulates the orbiter itself during launch and ascent. By using and carefully monitoring this sophisticated piece of test apparatus, engineers will have a clear understanding of how the X-33's umbilical system functions long before an actual launch. NASA engineers Greg Melton and Allen Littlefield designed this particular test device.



UMBILICAL SUPPORT SYSTEMS (GROUND SUPPORT FOR LAUNCH PAD SYSTEMS) ARE THE PRIMARY MACHINING CONCERN AT KENNEDY SPACE CENTER.

Boeing was the third shop I visited at KSC that uses Haas machines. Arlie Calhoun, lead machinist, clarified what it is they're immersed in. "Most of what we do here is for the payloads," he said. "Right now we're heavily involved in space station payloads."

The Boeing shop uses two Haas machines, a new VF-2 and a VF-8. Machinist Peter Koomjiam is presently working on an insert bearing machined from 6061 aluminum. The bearing is designed to provide an interface between the flight payload (in this case a space station element) and the lifting device. The lifting device is called the "strongback." The strongback is used to transfer the payload to a mobile transporter. The transporter then takes the payload to the launch pad, where it is installed into the space shuttle payload bay. In short, the insert bearing protects the payload during transportation to the shuttle.

The consensus of all three Haas-equipped shops at KSC is that it's a great source of satisfaction to be a part of the exploration of space and its concurrent impact on our future – to be mentioned, perhaps, in a paragraph on a page of history, in particular with regard to the new evolution of the space shuttle, the X-33/VentureStar.

The X-33 is the flagship technology that will dramatically lower the cost of space access. The reusable spaceplane will take off in a vertical position and use conventional runways to land horizontally like an airplane. The vehicle consists of a lifting body airframe with two cryogenic liquid propellant tanks – liquid hydrogen (LH_2) and liquid oxygen (LOX) – placed within the aeroshell; it will use two "linear aerospike" main engines. Water will be the primary by-product of the LOX/LH_2 combustion. The entire spaceplane (with all fuel tanks and engines) will take off and land as a single unit. The reusable launch vehicle will be capable of reaching an altitude of up to 60 miles and speeds in excess of Mach 15.

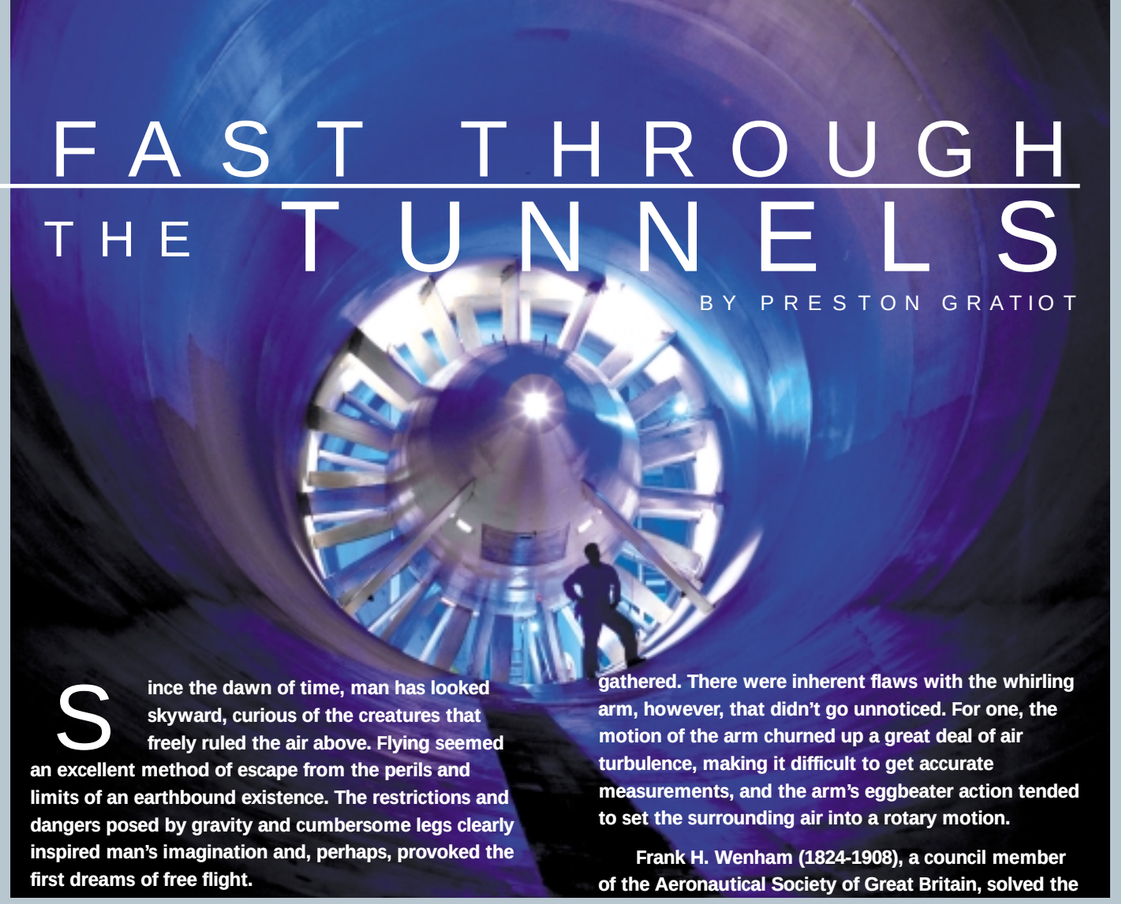
Today, as cliched as it may sound, it's clearly still reasonable to refer to space exploration as the final frontier. Tomorrow, led by NASA's reusable launch vehicle, we may be referring to it as something new – "open for business."

"Never become so blinded by the light that we forget to imagine, nor remember, how it feels to be amazed."

Unknown – 2000

FAST THROUGH THE TUNNELS

BY PRESTON GRATIOT



Since the dawn of time, man has looked skyward, curious of the creatures that freely ruled the air above. Flying seemed an excellent method of escape from the perils and limits of an earthbound existence. The restrictions and dangers posed by gravity and cumbersome legs clearly inspired man's imagination and, perhaps, provoked the first dreams of free flight.

Early seekers of flight patterned their machines after the one working example they had – birds. But it became staggeringly apparent that far more than watching birds was required to unlock the secrets of flight. Man quickly realized he knew nothing of the forces acting upon the surfaces cutting through the atmosphere. A method was needed to test the fanciful theories of human flight.

Recognizing – as Leonardo da Vinci and Sir Isaac Newton had before them – that they must either move test models through the air, or blow air past stationary models, these pioneers of flight were motivated to search for relatively steady natural wind sources. Models were mounted above windswept ridges and in the mouths of blowing caves. Alas, the perversity of nature finally forced them to turn to various mechanical schemes for moving models through still air. The cheapest and simplest contrivance for this was the "whirling arm," a sort of aeronautical centrifuge.

Up until the end of the nineteenth century, the whirling arm provided most of the aerodynamic data gathered. There were inherent flaws with the whirling arm, however, that didn't go unnoticed. For one, the motion of the arm churned up a great deal of air turbulence, making it difficult to get accurate measurements, and the arm's eggbeater action tended to set the surrounding air into a rotary motion.

Frank H. Wenham (1824-1908), a council member of the Aeronautical Society of Great Britain, solved the problem in 1871 by designing and operating the first wind tunnel. In Wenham's words, "it had a trunk 12 feet long and 18 inches square to direct the current horizontally, and in a parallel course." A fan-blower upstream of the model, driven by a steam engine, propelled air down the tube to the model.

With the advent of the wind tunnel, man's pursuit of flight began to soar.

The days of whirling models on the end of an arm have thankfully long been abandoned in favor of rigorous "flight" testing in wind tunnels. One of the largest collections of active wind tunnels and related support programs in the world can be found at NASA's Ames Research Center in California.

Modern wind-tunnel testing, however, goes far beyond that of simple airborne craft. Today, the tunnels at Ames serve not only NASA and its numerous programs, they are also reserved for a world of aerospace customers, and even the occasional full-sized 18-wheel tractor/trailer assembly. Yes, the study of aerodynamics is a science that affects us all, and NASA depends on modern technology to provide design information in a timely and extremely accurate fashion.

NASA Looks to Technology

"NASA is starting work on the next generation of space transportation access technology," says Pete Zell, Customer Technical Interface Manager for the wind tunnels at Ames Research Center, Moffett Field, Calif. "Our test facilities here at our Wind Tunnel Operations Division are ready to support these new programs with rapid turnaround of essential flight-test data – much faster than we did with the shuttle program. CNC machines are an integral part of the plan that brings this all together and allows us to do it faster."

Located on the southern tip of San Francisco Bay, the Wind Tunnel Operations Division specializes in aerodynamic testing and proof-of-concept projects. The normal workday can include everything from testing helicopter rotor blades to verifying airflow patterns on a supersonic air transport prototype. This testing is so important in today's world that it is not uncommon for these wind tunnels to run around the clock.

Cycle Times and Savings

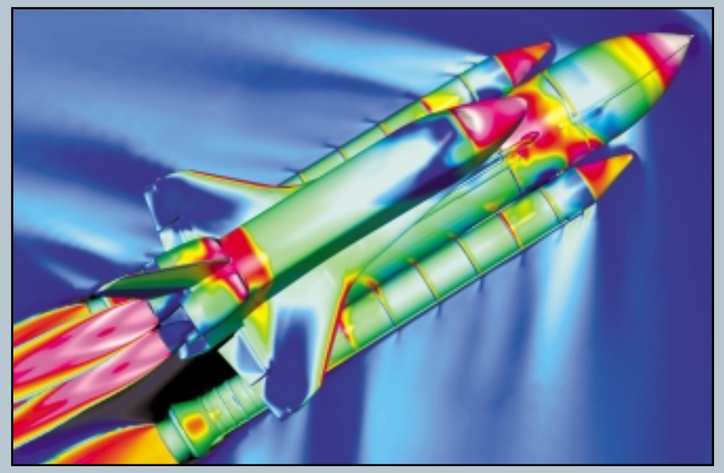
If you look at aircraft development in terms of time, it goes through a preliminary design stage, then into the concept development stage and then into engineering and manufacturing development. Only when the flight characteristics of a given design are proven do they go into production flight testing.

"A big chunk of this developmental cycle is wind tunnel testing," says Zell. "It's not uncommon to find extensive tunnel testing in the concept development and preliminary design stages of a given project. Then there's more in engineering and manufacturing development. One of our goals is to shrink these test windows so that customers get their information in a shorter period of time. This allows aircraft development to go from taking 'X' number of months to 'X' minus as much as we can deduct. The message we receive from our customers is, we've got to do it faster. We've got to give them the same quality, but do it in the shortest time possible."

With wind tunnel time running thousands of dollars per hour, time savings quickly become important to the customer. This is where the division's recently installed Haas CNC machining centers and CAD/CAM software come into play.

"We've got to be able to make parts quickly and get them onto the test model without delays or inaccuracies," says Zell. "Rapid turnaround is the impetus for placing the CNC machines near the testing facilities. It's one of the most important factors in our success. Then, if a change needs to be made to a model, it's just a matter of tweaking the component design a degree or two and quickly fabricating a new one."

Zell noted that some of the new things coming down the pike at the research center include a number of space transportation programs. "The X-34, X-37 and X-38 projects are all potential customers for our facilities. Where we previously did a lot of work on the space shuttle, we're now moving into the next generation of space transportation vehicles. That's what NASA's charter is all about: to be at the forefront of technology."



Wind-tunnel testing of scale models has advanced well beyond the simple verification of flight stability. Advanced technologies allow researchers to track the aerodynamic pressures that can be expected in actual flight conditions. Here, a test utilizing pressure-sensitive paint, which fluoresces under certain light conditions, shows the pressure patterns on the space shuttle at speed in the upper atmosphere.

A wind tunnel model is traditionally mounted on a long balance arm that registers the minute forces exerted by the model as it reacts to the airflow. Testing frequently includes various wing configurations with flaps and control surfaces in different positions. This is where the Ames Research Center CNC support system saves client time by providing rapid, on-site component fabrication to meet the customers' changing test needs. Parts that used to take weeks to arrive can now be made on demand.

Rapid-Prototyping Method

The wind tunnel support project developed out of the need to rapidly respond to customer requirements. "We needed to find a way to make model parts from structural aluminum and steel here on site," says Paul Keller, Experimental Facilities Development Engineer. "We do not fabricate whole models, but we need to provide design support for our customers that allows for their test variations.

"In the past, our customers would bring their model and all the test pieces to us for testing." Keller continues. "Then, in the course of running the wind tunnel test, they might see something in the data they wanted to investigate a little further. Without the ability to fabricate new parts on-site in a timely manner, they would have to reschedule testing for a later date. These delays usually proved costly."

New Technologies

"I was given the go-ahead to put some innovation in place to address the issue," says Keller, "and that is where the CNC machines and CAM software come in. The machining centers give us the versatility and speed we need, and the Surfcam gives us the ability to talk to a variety of CAD systems. This combination allows the guys in the Wind Tunnel Operations Division model shops to fabricate parts for our customers in a timely fashion.

"The CNC machining centers are a key part of making this support program happen," Keller adds. "We wanted a fairly large capacity machine, so we got one with 64"x32"x30" travels. We also got the multiple-axis rotary table, which gives us the ability to create components that demand more sophistication."

Time Saver Plus

Wind tunnel testing exerts forces on the model that are substantial, and that's why you will never see cheap, flimsy pieces on a test model. They have to be built out of structural billet, and they have to be machined and finished to a very tight tolerance. In fact, the performance of the model is directly dependent upon how accurately the required shape has been machined.

"It used to be that this required weeks or even months," explains Keller. "Now, we are expected to do the same thing in a matter of days. The CNC machines and CAM software allow us to work in a tightly integrated way with the engineers and designers as the testing goes on, so we are ready to go when they need to make modifications."

Customer Relations

"Our outside customers are excited when they see our CNC-enhanced capability," says Mike George, Division Chief of Wind Tunnel Operations. "Of course, it benefits them directly. We want it to benefit them. In fact, the whole point of this rapid response system is to improve our ability to focus on the customer's needs. They're happy when they can get parts made in such a short time.

"Our CNC-based system is also more repeatable, and more accurate. Nowadays, repeatability is the main factor. You always know how the part was cut, and you can easily substantiate your pathways."

Coordinated Efforts

The Moffett Field NASA facility has a customer base which is mainly, but not limited to, the aerospace industry. Many times, wind tunnel customers will bring in a model that's been fabricated elsewhere. But now, that "outside" model also comes with documentation that shows what was done. "We can then use that information to build up the locating holes and mating surfaces in our CAM system," says Jack Marsh, veteran model maker and operator of the new Haas VF-6. "That way we have the documentation should we need to fabricate any additional model components for our customers."

There is no limit to the amount of testing you can do with a model when you configure it for modular variations. "The only limitation is whether you can build it to meet the structural requirements. As long as you can make it strong enough, you can build in testing capabilities that will allow you to replicate most any flying attitude or conditions," explains Marsh.

If initial tests show a transitional phase between two setups, such as a theoretical stall condition, the CNC machines can quickly be programmed to machine new components in varying configurations until the optimum characteristics can be determined and recorded. Better to establish these characteristics in a wind tunnel that at the hands of a human test pilot.

This infusion of CNC technology has become an important part of a suite of testing that the Ames Wind

Tunnel Operations Division offers its customers. "It is unique in that every one of these advanced test techniques, including rapid manufacture of test model components along with speedy graphic acquisition of data, makes for a much more productive wind tunnel test," explains Marsh. "More so than even just three or four years ago. We – and our customers – have seen dramatic increases in productivity because of this integrated wind tunnel support program."

CAD/CAM For Toolmaking: It Really Is Different

Story
Bart
Simpson

The process of choosing CAD/CAM software for production machining is usually straightforward. Managers can't go too far wrong buying the package with the most features at the best price. However, if one is making tooling, the choice is anything but easy.

Tooling, especially tooling made for complex injection molding, forging dies and casting dies, is full of highly styled curves and artful shapes. Whether the designer's intent was to replicate a lifelike image, or to fit a form to the human hand, the resulting sculptured forms can heavily tax typical production-type CAD/CAM packages. They often lack many of the special capabilities required for producing all but the simplest tooling.

This is not to say that the doubly curved core and cavity surfaces cannot be manufactured with production-type, or conventional, CAD/CAM. In fact, it's done every day. But conventional CAD/CAM is solids-based, and using it for tooling is cumbersome. The CAD file may look good, but fillets and blends joining adjacent surfaces may be missing or incorrect. This forces CAM programmers and machinists to "eyeball" many fine details. The result is that the tool, and hence the product, never quite matches the design. With more companies using mathematical models rather than solid models – and inspecting to those models – the drawbacks of conventional CAD/CAM are becoming obvious.

Even a brief look at the differences between job shop machining and the production of tooling reinforces the point. Mold makers carve tooling from blocks of steel costing thousands of dollars. Many CNC machining jobs begin with steel preforms costing a few dollars (or just a few cents). Every mold is unique, so no two mold jobs are identical. Job shops often produce hundreds or thousands of identical parts. Molded parts must have visual appeal, while job shop-machined parts are usually unseen components.

Tooling businesses have very different drivers, too. Tooling shops generally compete on the basis of delivery time, including the ability to handle frequent engineering changes. Concurrent engineering eliminates much of the bureaucracy and multiple reviews of new-product development, and many sequential tasks are now done simultaneously. Product changes and redesigns are often executed *while* tooling is being built, not before, resulting in engineering changes. Deadlines, however, are almost never extended.

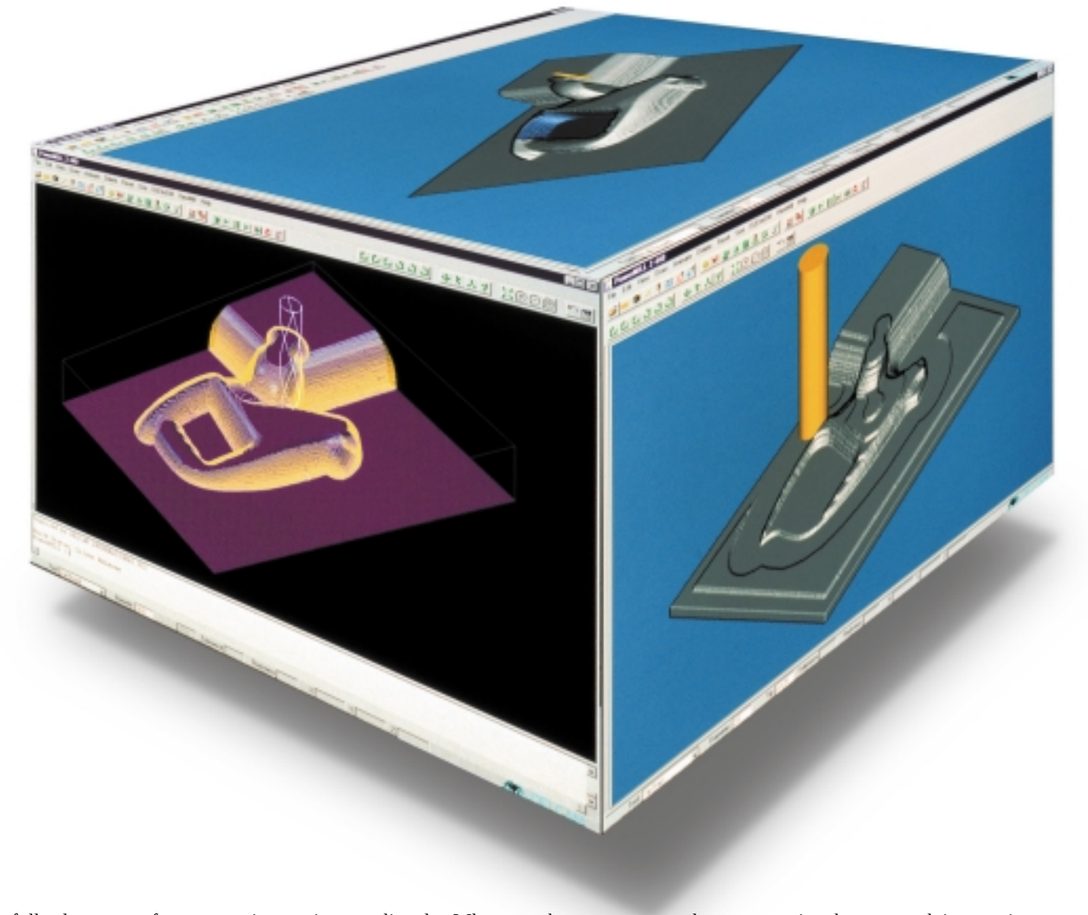
Tooling businesses and production shops also get their data in very different ways. Production shops generally have CAD systems in common with their largest customers. Depending on the industry and type of work, one of the major CAD/CAM systems is usually a de facto standard. Where different systems are in use, DXF, IGES and other geometry translators usually suffice.

Tool shops rarely have this luxury. Typically they must work with many customers who have different systems, so geometry translation is inevitable. Moreover, tool shops have to design the product they make – the tool – themselves, deriving the necessary geometry from the customer's model of the finished part – a model that is often flawed.

MANIPULATION, TRANSLATION AND RAPID RECALCULATION

All this adds up to a need for software that has been developed for mold making. In CAD, surface manipulation features must be extensive – and highly interactive. The package should handle solids and surfaces in the same database, and should have powerful features for finding and fixing surfaces that are missing or incorrectly trimmed. This defines the need for best-in-class software; this is what puts them at the "high end" of the CAD/CAM market.

In CAM for toolmaking, rapid recalculation is vital. Toolmakers and programmers may dry-run half a dozen different machining strategies before they find the one that best balances metal removal rates against surface finishes. Mold shop engineers and programmers take



full advantage of every cutting option they can find or invent. Fast-running code, and especially fast toolpath recalculation, is not a luxury in toolmaking – it's a necessity.

Major challenges in mold making which must be addressed in CAD software:

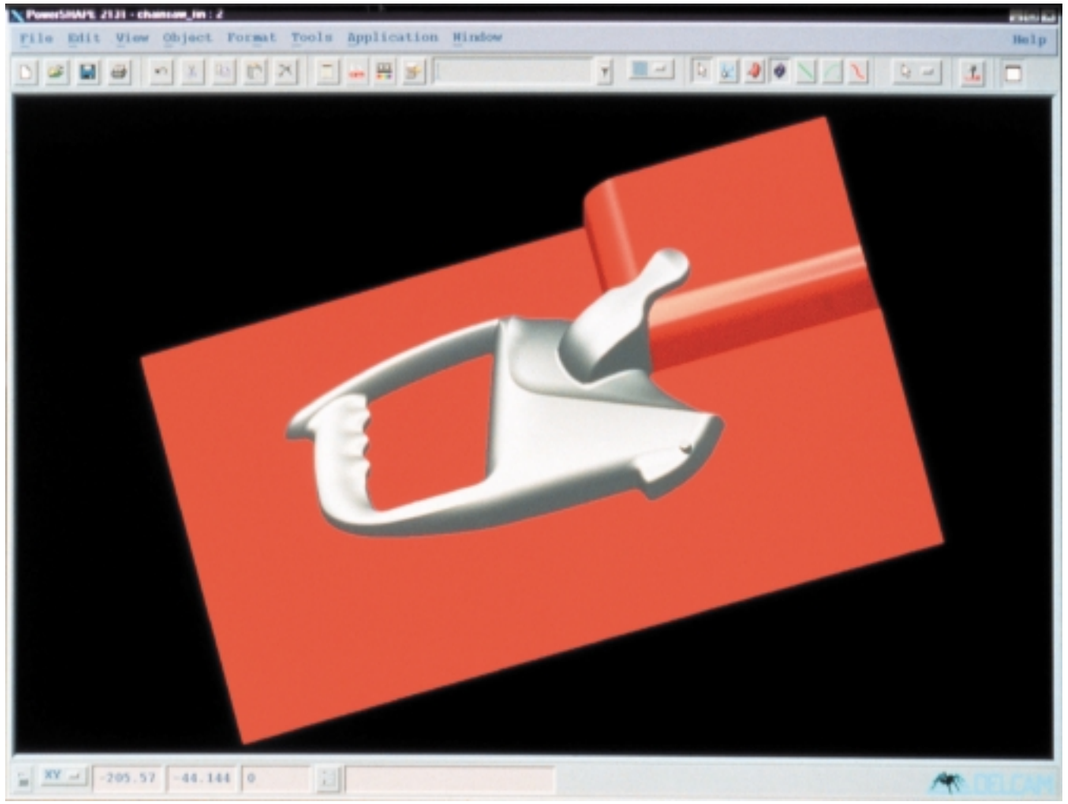
• There is little time to optimize toolpaths, even though a single mold cavity or core may use dozens of them. Instead, the software has to optimize automatically. Since few toolpaths are ever used more than once, it is nonsense to spend hours optimizing one of them to save two minutes.

• In production CAD, CAM and CNC work, geometry is machined directly: Whatever the customer sends to the shop, the shop sends to the machine tool. This is not true in toolmaking. Tooling customers send a CAD model of the part to be made. The toolmaker turns the exterior surface of that model inside out to get the mold's cavity. Thus the cavity produces the part's exterior, visible surface. The geometry of the cavity surface is then offset by the thickness of the material to be molded to get the surface of the tool's core. Since the core forms the part's invisible interior surface, tolerances are loose and surface finish requirements are minimal. But the mold's core is often extremely complex, as it must also form the part's internal stiffener ribs and mounting bosses, and it contains any slides and lifters that must be used.

• In mold geometry, sharp corners are no-nos. Wherever any two surfaces join, they are filleted; wherever there are three or more surfaces, they are blended. Mold making requires that the fillets and blends meet their adjacent surfaces precisely.

• Every flat surface that is parallel to the tool's direction of "pull" (the axis of its opening) must be flared slightly outward. Without that, the part will stick in the mold, which could cause a tooling crash costing the tool shop or molder thousands of dollars. Tooling shops need software that creates draft angles quickly, and that highlights

Bart Simpson is the International Marketing Manager of DELCAM International Inc.



surfaces that should have been "drafted" but were missed.

• Deciding which parts of the product are to be molded in the core and which in the cavity can be tedious. But this can be done instantaneously in tooling-oriented software once the mold's parting line has been established.

• Toolmakers must create "run-off" surfaces and mold locks. These clamp the tooling closed and seal it against the pressures of the injection molding or die casting machine's cycle. The functionality needed for these tasks is not included in CAD/CAM systems developed for production CNC work.

• When tool details are simply too delicate to be machined, these surfaces are created with electrical discharge machining (EDM). Tooling software must be able to generate three or four identical EDM electrodes by extracting the geometry from the tool's cavity surface and inverting it.

VIEWING, "HEALING" AND TOLERANT MODELING

Toolmakers have endless geometry problems with customer files. Among the most troublesome are tiny missing surfaces at the bottoms of corners and blends, and tiny gaps between surfaces that should be joined. Much attention has recently been lavished on healing, especially the online variety where the Internet is used to send files to vendors for a fee (with no guarantee of security or success). A smarter alternative is to reverse this process, downloading the software for healing and keeping huge tool design files off the Internet.

Even better is tolerant modeling. As the name implies, tolerant modeling allows the user to establish a tolerance for geometric errors, for example, 0.010 inch. Gaps and missing surfaces below that size are simply ignored by the software. The cutting tool goes right over them, as if they did not exist. Healing, on the other hand, involves recalculating the trim boundaries of adjacent surfaces more precisely. Theoretically, healing offers greater accuracy, but there can be a steep price. If there are significant differences in their tolerances relative to the size of the part and "size of the world" parameters, models cannot be exchanged between CAD systems.

A viewer that can support all of these functions is invaluable. The viewer provides read-only access to anyone outside the tooling company who needs it – people in marketing, documentation and purchasing, for example.

Good toolmaking software offers a "hybrid modeler": databases and functions that operate equally well with solids and surface models. Surfaces are clearly preferred over solids for most of the work, especially in the cavity. Trying to create sculptured "organic" or ergonomic surfaces by building them up from hundreds of tiny solids is a form of mental cruelty. Solid modelers often lock up under the calculation loads.

Nevertheless, solids have a valued place in toolmaking – as the accompanying line drawing shows. This is the geometry for the core of a tool that molds handles for chainsaws. A great deal of the handle's strength comes from the "fish bone" ribbing formed by this particular mold core. The complex ribbing was created with solids, draft-angled, then merged into the surface geometry of the core – all in a matter of minutes.

ACCOMMODATING ROUGHING AND FINISHING STRATEGIES

Rough machining is only occasionally part of some production CNC work, since carefully sized, often preformed, stock is loaded into the machine tools. Toolmakers, however, start with rectangular blocks of tool steel often costing thousands of dollars. In making large tools, hundreds of cubic inches of steel must be "cleared" as quickly as possible. This is especially true of tools for auto bumper fascia and instrument panels. CAM capabilities for this include offset and profile area clearances, block definition, auto-angle raster roughing, climb and conventional milling, pocket milling and skimming. All of these techniques are designed to remove as much metal as quickly as possible.

Because the cavity, the most critical part of the tool, is recessed into the steel block, a large range of additional cutting strategies is required. Many of the milling strategies most useful to tool shop programmers would be exotic in a production machine shop. These include raster for flat or shallow areas, constant Z for steeply sloping areas, and rest milling, pencil milling and corner picking for small internal corners. Yet these and many other strategies are in everyday use in mold shops, and must be accommodated by the CAD/CAM software packages they use.

Many of these cutting strategies are also used in finishing. Roughing typically machines cavity and core surfaces to within 0.030 inch tolerances. The steel is then sent out for stress-relieving. When it comes back from the heat-treater, finish machining begins. Mold shop engineers and programmers make dozens, if not hundreds, of toolpaths for finishing. They do so for several reasons. These include:

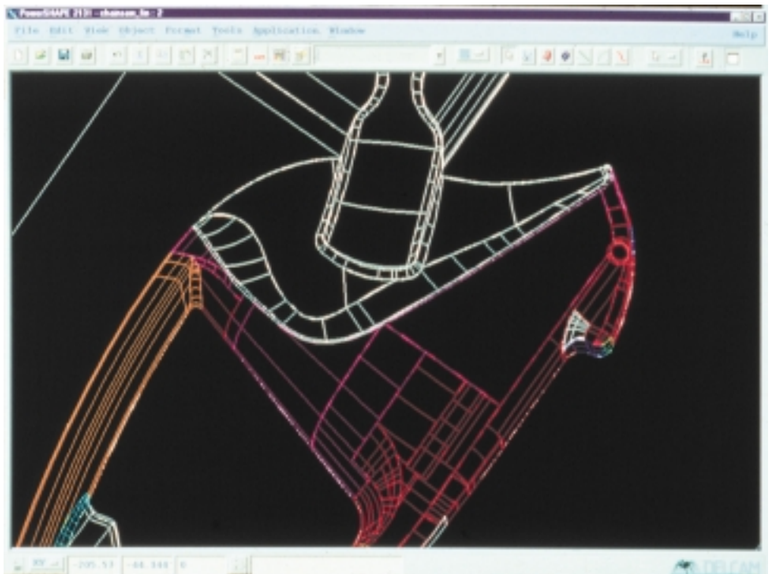
• To guarantee the tool's dimensional integrity and hence the cast or molded part's accuracy and conformance to its designer's intent.

• To reduce or eliminate slow and costly hand finishing.

• To reduce the need to resort to EDM. Setting up and programming EDM machines is tedious, and EDM is five to 10 times slower than cutting metal, not counting the time needed to make EDM electrodes.

Despite the length of this piece, we have just scratched the surface of what CAD/CAM is all about in making tooling. A good tooling package has literally dozens of features not found in conventional CAD/CAM offerings. Doing without any one or two will not bring economic ruin. But trying to use production-type software for mold making can add hundreds of hours of needless work. This alone can make a shop uncompetitive in bidding, and unprofitable if it somehow does get the work. Without many of these features, it is the tool shop's machinists who will actually determine the dimensions and tolerances of the core and cavity surfaces.

DELCAM International Inc.
Windsor, Ont., Canada



Haas Rocks the Valley

Rock Valley College in Rockford, Illinois, was founded in 1964 as a liberal arts community college. At the time, its Technology Division was a small part of the school – that has changed considerably.

Story
Linda Dorr & Stan McCord

Photos
Sherry Pritz

Today, the Technology Division at Rock Valley is well known locally for its two-year degree programs, as well as the non-degree courses available there. Between 500 and 600 students a year attend Tech Division classes. These include Computer-Aided Design, Building Trades and Automotive Design programs, in addition to a CNC training program.

Much of the reason for Rock Valley's reputation is the 3,000-square-foot manufacturing lab housed in the school's Technology Center. The lab was originally a grant-funded, demonstration-only manufacturing cell that showcased the state of the art in lights-out manufacturing. While the lab's computer and CNC technology were the latest and greatest industry had to offer in 1988, lab visitors only got to look – they couldn't actually use any of the equipment. This began to change a few years later, when the Tech Division started developing a CNC training curriculum. The early CNC classes quickly made it evident that, in addition to classes in blueprint reading and measurement, machine tool operation and G-code programming, students needed hands-on practice.

The first hands-on CNC machines at the Technology Center were of the table-top variety: a small lathe and a milling machine. Their presence meant the lab was no longer a demonstration-only showroom; now it had a training section. In 1990 the Tech Center bought its first Haas vertical machining center, a VF-1, and continued to use the table-top machines as well. Due to the low cost and excellent performance of the VF-1, plus the success of the classes, another VF-1 soon joined the first machine.

By 1995, Rock Valley's CNC training program had grown to the point where the table-top machines were sold and two more Haas machines – a couple of HL-1 lathes – were brought in. Stan McCord, head of the Automation Skills program (and instructor of the fourth-year precision machinist course, which focuses on CNC applications), notes that, "The machines were attractive, easy to use, and they were full-sized machines. Table-top machines can only perform so well, and we wanted to use and teach with actual industrial equipment." By this time, the manufacturing lab had been converted to a full-time training lab where all of the machines were for hands-on use.

Today, by the time students complete the CNC courses, they can perform simple job setups, set tool offsets, use wear offsets, and they have a good grasp of cutting tools and their operations, as well as control utilization. Students also learn basic machining operations, tool selection, feed and speed calculations and program formatting. Advanced classes are also available for experienced machinists to learn more about programming and tooling applications.

The faculty's desire for students to learn on industry machines wasn't the only motive for upgrading the lab. The Technology Division at Rock Valley College has a conference center that is often used by local companies. "The conference center looks down on the lab," explains McCord. "Industry customers saw those table-top models and thought students weren't learning on 'real' machines. And we wanted students on the real thing as well."

Rock Valley replaced the original machining centers in 1997, purchasing two new VF-E models with probe systems and rigid tapping. The school also added a third HL-1 lathe that year. Class size in the Technology Division is in the range of 12-15 people, and having three turning centers means more hands-on time for each student. Another VF-E was added in 1999, and in June of this year, the two original HL-1 lathes were upgraded to new SL-20s. According to McCord, "Rock Valley is committed to bringing the latest technology to our manufacturing students, and Haas has made it possible for us to do so." New lab exercises and projects have been added to the curriculum to further expand student experience.

The CNC machines at Rock Valley are used for classes in the Automated Manufacturing degree program, in the Automation Skills vocational program and in the Precision Machinist program that is part of a tool & die apprenticeship. Each semester sees 50 to 75 students using the Haas equipment. Many of the students in the CNC training program – and all of the part-time instructors – work full-time in the manufacturing industry and spend their evenings in the classroom. The instructors bring real-world experience into the classroom, to the great benefit of the students. Several of these part-time instructors are graduates of the Rock Valley program who return to pass on what they've learned.

Many regional companies take advantage of the classes and lab equipment at Rock Valley to train new operators. This summer the Tech Center ran a CNC setup and operation class for Greenlee Textron, a local manufacturer. The nine students were all Greenlee employees who wanted to upgrade their skills to qualify for CNC openings. Like the average student in the Tech Division, the Greenlee class had some shop skills and represented both genders and all ages and ethnic backgrounds. The class started out on the vertical machining centers and then moved to the lathes. While several of the students had worked as fill-in operators, none of them had ever set up a CNC machine. Within a few weeks of starting the class, they had learned to use the control to establish work offsets and tool length offsets, enter commands through MDI and set up tooling, as well as learning the principles of safe operation through single-block usage and rapid travel reduction. The class instructor, Mike Tremble, was a student in the Rock Valley CNC program when it began in 1990. Tremble now sets up, operates and programs CNC machines for Osmonics, another local company. He credits Rock Valley with giving him the "boost up" he needed to find a job as a CNC machinist, and feels it's a "great accomplishment" that he can return to teach the classes to others.

Gordon Skattum, Director of the Technology Division, notes that, "Today, companies look for fast-track, state-of-the-market education and training." The Tech Division's CNC training program provides just that. Woodward Governor, Ingersoll Milling Machines, Sundstrand Aerospace and Barnes International are just a few of the local companies whose CNC operators have attended classes at Rock Valley. Gordy Skattum notes further that "the challenges facing U.S. manufacturing [include] a shrinking workforce, demand for higher skills, explosions in new technology and issues of higher quality and productivity. The ongoing partnership between Haas Automation and Rock Valley College is helping to meet those challenges."

CMTSE continued from page 13

longer in the business."

With more than 25 years in the business, Arthur notes that, "Selling is a lot about comfort and respect, and a customer is more likely to respect a salesman because he has done something like this on his own and achieved certification. I definitely see value. I'm very much in favor of education."

AMTDA requires all CMTSEs to recertify every three years through documented ongoing professional development, such as participating in continuing education, active membership in professional organizations, publishing articles and a variety of other activities to maintain proficiency.

According to R. Stephen Flynn, a CMTSE and President of the Haas Factory Outlet in Fairport, N.Y., "Making the commitment to become a CMTSE is also a commitment to continuing education. It's easier than ever to take advantage of the many educational opportunities available today – night classes at a local college or university, seminars on topics pertaining to the industry and Internet-based courses, to name a few. CMTSEs realize that continuing education leads to self-improvement. The three-year recertification process serves as a continuous opportunity for CMTSEs to map out their educational goals. Those who have made the commitment to continued self-improvement become a more valuable resource to their customers."

Sales engineers who work toward CMTSE certification obviously gain knowledge and experience from the process, but they also gain a great deal of self-respect and confidence. Those intangibles will show over time as CMTSEs work with customers. According to Steve Huser, a CMTSE and President of the Haas Factory Outlet in Tempe, AZ, "I'd participate in the CMTSE program again, even if the designation wasn't a requirement for HFOs. My salesmen have definitely developed more self-confidence, and involvement shows customers that you've made the extra effort. The CMTSE certification simply validates that effort."

Huser also noted the "increased camaraderie generated among sales engineers during the preparation process. We conducted study sessions using the Candidate Study Guides as our preparation outline. I encourage this activity, as we all learned from the process."

AMTDA is very pleased with the comprehensive Candidate Study Guides and their effectiveness in preparing candidates to sit for the examination. "This program is noteworthy not because of the exam or designation, but because of the process to increase the knowledge base of our industry's sales engineers," says Greg Safko, AMTDA's Senior Director of Member Resources, who oversees the program. "It is truly an education and training program. The Candidate Study Guides, which were developed as a resource for machine tool sales engineers, are constantly updated to reflect the changes in technology, new manufacturing processes, sales methodology and industry marketing trends."

Machine tool sales typically involve large amounts of money and extensive negotiations. The CMTSE process adds credibility, because the salesman is knowledgeable in both the technology and sales administration. In short, he can professionally sell machine tools. But, the program also raises the level of expectation for machine tool sales. Haas Automation relies on its HFOs to incorporate CMTSE certification as a basic requirement when hiring and training new sales engineers. Certification requires a salesman to know and understand the manufacturing process and have a basic understanding of business.

While the CMTSE certification process does not make sales engineers specialists in every type of machine tool, it does broaden their expertise. As a result, they can offer customers more specific solutions to their manufacturing problems. For Haas Factory Outlets this results in enhanced competitiveness, an expanded customer base and more satisfied customers. Any advantage for a company starts with sales – with the impression that salesmen make on the customers. Lots of good machine tools are available in the marketplace. From a competitive standpoint, the better job a salesman does representing the product, the better chance he has to get the order.

The CMTSE designation is becoming the standard within the industry. Eventually, it will be a benchmark. Achieving certification demonstrates meeting a certain criteria of knowledge above the entry-level person, and demonstrates an active involvement in the industry. The thought that the CMTSE designation may become as recognizable as, for example, the CPA, is not as remote as some may think.

"CMTSE" – look for it when doing business with Haas.

EUROPE continued from page 3

Kingdom through Haas Automation U.K., Ltd., with no change to that organization, and will also continue its existing relationship with the Machine Tool Division of Mikron (recently sold to Agie-Charmilles). The Haas products represented by Mikron will continue to be delivered as private-labeled, Mikron-branded products according to an agreement reached with Mikron and Agie-Charmilles. Mikron will retain exclusivity to the Mikron-branded products while Haas will market under the Haas brand name.

"We believe the Mikron-branded product will continue to grow at the same levels the organization has seen over the past five years," says Denis Dupuis, General Manager of Haas Automation. "By marketing the Haas-brand products directly, we will reach a different segment of the European market that is currently not being explored."

25,000 continued from page 3

Haas Gen Mgr Denis Dupuis, left, presents Chuck Thudium, Jim Archer and Lyle Archer of AT Precision with a plaque commemorating the 25,000th Haas CNC.

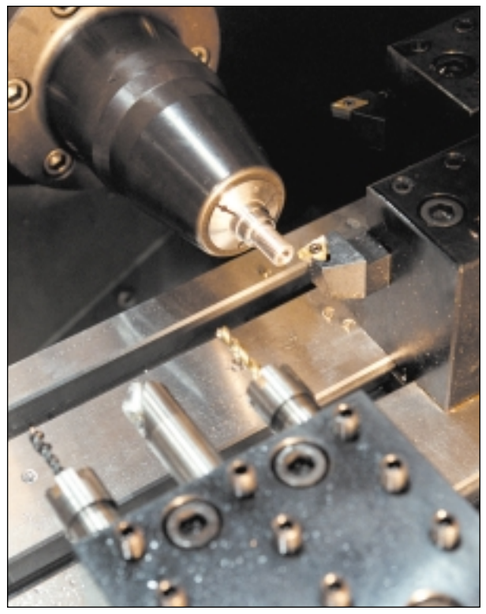
in Oxnard, California – which averages production of more than 400 machines per month – has allowed Haas to reach the milestone 25,000th machine in a mere 12 years, while at the same time reducing prices across the board.

Since the introduction of the very first Haas VF-1 vertical machining center at IMTS in 1988, Haas Automation has earned a worldwide reputation as a builder of high-quality machine tools designed to keep job shops and manufacturers up and running. The company moved to its present 620,000-square-foot Oxnard location in March of 1997, and continues to grow and increase its market share annually.

At a time when many manufacturers are moving production offshore to reduce costs, and the market is being flooded with low-priced imported machines, Haas Automation continues to provide the world with a complete line of high-quality, affordable, American-made machine tools. Haas currently ships more units per month than any other machine tool builder in America.

It's The Right Tool in Chicago at IMTS 2000

Ten thousand square feet of booth space, 30 machines making chips and standing room only. That was the scene for eight straight days in the Haas Automation booth at IMTS 2000 in Chicago, September 6–13.



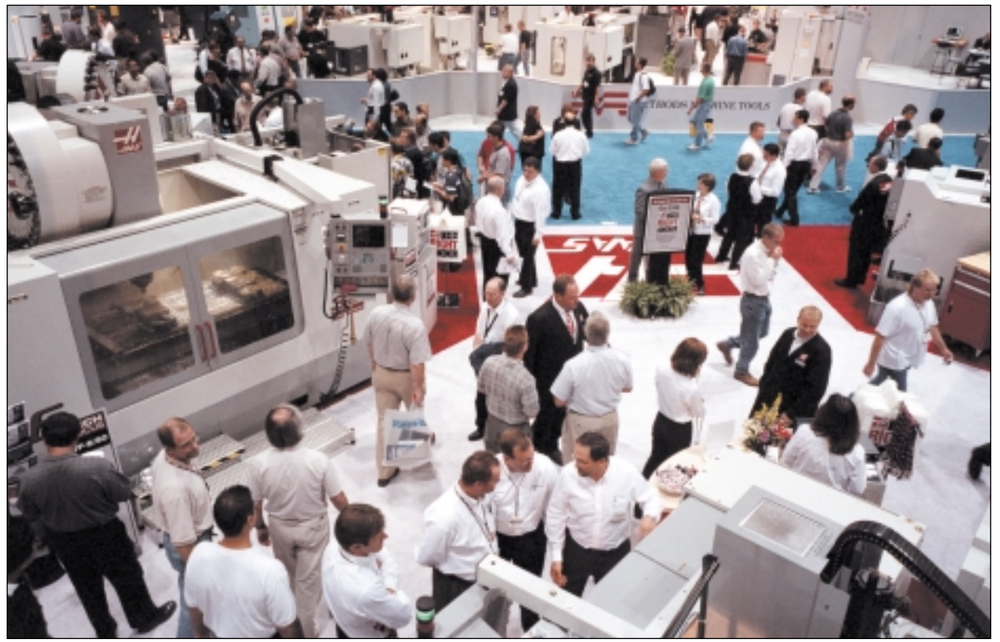
Record numbers attended this year's International Manufacturing Technology Show, and the Haas booth was by far the most popular. According to show management, Haas Automation logged more than twice as many leads as any other exhibitor at the event.

With many exhibitors cutting nothing but air this year, the Haas booth was somewhat of an anomaly, as all 30 Haas machines ran non-stop throughout the show, cutting through more than 70,000 pounds of aluminum, brass, 1018 steel, cast iron and H13 tool steel.

As if that wasn't enough to draw attention, show attendees were kept on their toes throughout the various exhibit halls by roving Haas employees randomly distributing $100 bills to those seen wearing "The Right Tool" buttons. A total of $5000 was handed out to lucky attendees caught displaying the distinctive Haas buttons.

Visitors to the Haas booth could also register to win a brand-new Mini Mill valued at $30,000. By swiping their attendance cards at the booth, they were automatically entered in the contest (non-attendees could enter, as well, by filling out a form at their local Haas Factory Outlet). The winner was selected after the closing of the show from a total of 10,998 entries (10,349 from the show and 649 from local HFOs).

Entries were compiled into a database, then arranged in alphabetical order and assigned a number from 1 to 10,998. Gene Haas, president of Haas Automation, then used a random number generator to select the winning entry.



The lucky winner was Mindy Driscoll of Hamilton, Michigan. She and husband Tom operate Driscoll Machine Shop Incorporated, a small job shop that services the plastic injection molding industry. The new Mini Mill will be their first Haas machine.

As expected, the new Haas products displayed at IMTS drew much attention from attendees and the trade press alike. In particular, the small-footprint machines – the Mini Mill, Mini Lathe and SL-10 – proved quite popular, as did the various five-axis machines – the HS-1 Auto Bar, the VF-5TR trunnion machine and the VR-6 router.

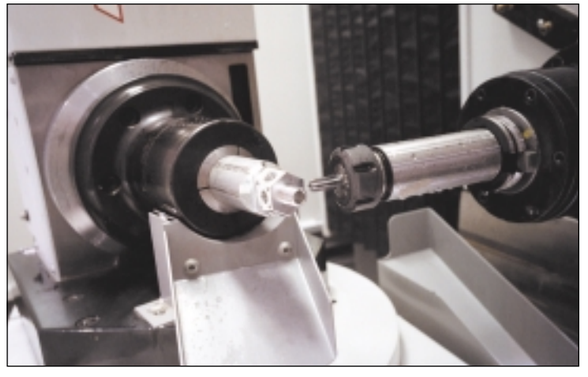
For those unable to attend this year's show, or who just want another look at what was there, here's a selection of images from the Haas booth.

Top left: A close-up view of the new Haas Mini Lathe cutting a part. This prototype machine got almost as much attention as the Mini Mill.

Lower left: The prototype HS-1 Auto Bar, a five-axis HMC with bar feed capabilities, also attracted much attention during the show.

Top right: The Haas booth was by far the most popular, logging more than 10,000 visitors in just a few short days.

Bottom right: A close-up view inside the HS-1 Auto Bar showing a typical part being machined.



HAAS

THE RIGHT TOOL