Pushing the Edge…
A Small Huntsville Rocket Company That Thinks Big!

Located in a small commercial building just outside of Huntsville Alabama, is Orion Propulsion, Inc. Its unpretentious exterior belies a hive of high tech rocketry and entrepreneurial activity taking place inside.

During my recent visit to interview Tim Pickens, the company's amiable President, I seemed to be interrupting a technical test of some pretty sophisticated equipment in the main workshop. Tim explained that his team was conducting a flow test. Upon seeing me take a step backwards he quickly put me at ease by explaining that the flow test was of liquid Nitrogen and nothing potentially lethal. My pulse slowed but it made me appreciate the amazing and delicate work that people like Tim and his team take in their daily stride, designing new, potentially highly dangerous liquid and solid rocket engines.

If he wasn't so young and energetic, you might call Tim a "good ol' boy" from Alabama -- don't let his mild-mannered alter-ego fool you. Tim's a high octane missile man who thinks way outside the box when it comes to designing and building some very edge of the envelope flight hardware. His thought processes have just landed his company a place at the high altar of space exploration; a part of the newly awarded contract for the upper stage of NASA's new Ares Rocket. But more about that later …

Tim grew up in ground shaking earshot of the huge rocket test stands at the Marshall Space Flight Center. His dad, an engineer/inventor, taught Redstone missile school and worked on Skylab, would call Tim and elder brother Randy to inform them that a test was imminent. The first indication anybody had was the piercing single tone of the world's largest and loudest bullhorn, placed next to the 40 storey test stands, warning the surrounding towns that the mighty Saturn V F1 engines were about to be lit. Though his house was over 10 miles from the test stand (colloquially known as the Devil's Bunsen Burner), Tim would watch his house windows vibrate under the unbelievable sonic pressure waves generated by the test of the five 1.5 million pound thrust engines. Tim explained, "You can't hear that and not be impressed!" That said, he credits his dad and brother Randy for giving him a lifelong interest in space and rockets.

Tim's playful experimentation as a child would give most parents today, apoplexy and no doubt, caused his parents extreme consternation. At age eight he began making gunpowder from its component parts, purchased from the local drugstore. One particular experiment set fire to a tree which he claims became an awesome fireball. Quickly, he realized that parents were going to become involved and they would not be telling him what a clever little fellow he was.

At 11, he built a gasoline and compressed air rocket, using tin cans. He'd rigged up a flow of gasoline, plus a compressed air hose, along with a spark plug wired to the lawn mower (which he describes it as a Rube Goldberg moment). Using the lawn mower, he tried to start the whole thing by pulling the starter handle. He went on to tell of how there was a whoosh and then how the gas started to flow down the driveway towards the family garage with the flames quickly following. Tim's dad luckily intervened and a disaster was averted. That didn't end as badly as the gunpowder but you can see that his experimentation at this young age could be extremely dangerous. Tim went on to build and fly Este's rockets, including their Redstone model. He built, flew and crashed many cable controlled airplane models and decided very early on that engineering design was where he wanted to make his career.

At school, he loved science and reminisces that just like Wernher von Braun (a personal hero), he didn't excel in Math. He loved the design-side of things, cutting metal and engineering items, but realized later on that, without the math, he could only go so far, before hitting a design brick wall. "You don't have a lot of time to do things so you need to use the best tools available to you" and so he decided he needed the Math. At college he "dabbled" with Chemistry, Math, Engineering, CAD and machine shop classes. "Anything that would help me to get closer to building rocket hardware!" It was his wife who finally complained to him that he needed to get a real world degree and so he eventually graduated from Faulkner University, with a degree in business. He modestly asserts, "I didn't get too heavy into the science, because if I did need something more substantial on the in-depth side of things, I could always ask someone else to help who was more knowledgeable in that area."

In the early 1990's and along with some friends, he joined the HAL5 club; a true grass roots, amateur rocketry group, which was a part of the National Space Society. The team would brainstorm and try to come up with any way they could launch even a roach into space. Visiting scrap yards to acquire materials became a major pastime. Their motto was "50 Miles or Bust".

Tim explained, "We'd visit a scrap yard and see a tower that looked like it could be a test stand, which meant that we didn't have to build the whole thing. We'd cut the legs down and modify it to our needs. That's how we got things done quickly and cheaply." He goes on, "We were working real hard, at least two nights a week we were firing off pyros on my driveway. We were doing most of this at my house. I realized early on that I needed a lathe and a milling machine to be able to do what we needed, so I bought them and placed them in my garage. This was costing me some money and my wife had to explain to the neighbors and family that this was Tim's dream, even though I didn't know when the payoff would be."

At the same time Tim was modifying cars because he loved to drag race. He bought and modified a mid-engine Volkswagen Aurel, which he used to race at the local drag strip. "I'd leave the line and pull a wheelie down the strip. Man what a rush! I've still got that rush for speed hiding in my genes!"

In 1990 he was attending the Huntsville Amateur Rocket Association events where he would build rockets and fly them. He was flying Este's rockets but realized that he had to think outside the box in order to push things to the limit. He didn't feel that he could compete with the big boys like George Gasaway from the national teams, unless he got into the propulsion system and built something different. His answer in the early 90's was that he decided to build a steam rocket.

"I'd been amazed at what Evel Knievel had done with his X-1 steam rocket that had been designed by Bob Truax. I'd always been a big fan of Truax -- he went all the way back to Goddard."

He decided that he wanted to place a video camera on top of a rocket and launch at least 10lbs to 2000 feet for no more than a couple of bucks, he felt that steam was the answer. So he built an eleven foot tall, eight inch diameter steam rocket fueled with 22lbs of water.

"When I turned up at the NAR event, I'd set up the gantry and placed the rocket on it, then I'd walk out with these two large containers of clear fluid. People would ask, 'What is that?' and I'd say it was just my rocket fuel and they'd say 'Pickens what are you doing?' and I'd answer, don't worry it's just water!"

At this point he would fill the rocket and place a generator near to the gantry. Then he would place two wires from the generator into the water fuel tank in the rocket and put a current across them to heat the water. "The wires went straight into the water, with no heating elements. I had to submerge them completely, so that they didn't burn up and I'd add a little salt to the water, to get the conductivity up a little."

"I had the cables run in an umbilical to the generator while it was heating and I had a pressure valve so that I could watch the build up. I was standing about 100 feet back with a lanyard so that I could pull the valve on the engine for launch. When the pressure reached 400 psi, I'd pull as quick as I could on that wire and the hold down nozzle would release. That baby had 500lbs of thrust for one second. It would throw that rocket to 2000 feet and it weighed 55lbs at lift off."

He later wrote an article for High Powered Rocketry called "Hot & Steamy". It was published and he got a lot of letters about it, including one from Bob Truax.

Due to the rules regarding NAR insurance and materials used, he was unable to keep launching at these types of events and so he had to move on to the High Powered Rocketry venues. By this time, he was staging rockets and even using retro rockets to slow down vehicles. Friends wondered what he would turn up with at the next event. "I was really trying to push to the edge within the rules. I'd seen Gasaway launch his sun-seeking rocket and that was impressive, I really wanted to learn and excel with whatever project I did next."

At this point in the interview, I asked Tim what he felt was the most difficult thing about high powered rocketry. Rocket Science has always been associated with things that are difficult, and I was interested in the reasons for that assumption.

His answer went through the issues of the enormous and violent flight regimes that a larger rocket goes through, especially when going through the transonic or Max Q period when the vehicle is under the most strain from the air passing over it and the supersonic shockwaves that are moving down the vehicle and coming off all of the components on that same vehicle. Another component of what the vehicle has to contend with is the huge acoustical impact from the engines themselves buffeting the vehicle. States Tim, "That's why Burt Rutan has been very clever with his air launch systems because he gets over most of that problem by having a high altitude launch." He went on to explain that with vertical launches such as the Space Shuttle, the enormous amounts of water thrown onto the pad are not to protect the pad, but to cushion the vehicle from the acoustic battering from the engines, at lift off.

"One of the other most difficult things to deal with is the combustion chamber itself, which has an internal temperature of 6,000F degrees, whereas the chamber containing that hot gas maybe has a melting point of only 2,000F degrees. To overcome this, we need to cool the chamber by circulation of fuel around the internal walls of the chamber, as it is running. These are difficult things to do!"

He went on to explain that there were many differing and sometimes opposing forces that have to balance just right so that the vehicle performs to its maximum potential. "Everybody --even the big boys -- have to call in the greybeards sometimes, because they all need experts at some point or other."

Tim prefers to think of himself as an elegant designer and creative thinker. He maintains that no matter how much money you spend or how many engineers you put on a (engineering) project; if it's a dumb idea to begin with, it's not going to work. He states quite correctly that liquid propulsion systems like the Space Shuttle Main Engine (SSME) are about as efficient as we can go, with that

type of system. The liquid rocket engine is not much different than it was 50 years ago, at the start of the space age. We have tweaked them about as far as we can go and unless someone actually discovers Unobtainium, then we are left with what we have. This does not, however, mean that creativity cannot be thrown into the mix and to think of better and more efficient ways of building the systems that can get us into space.

I'd asked him if he felt that modern rocketeers spent too much time on CFD studies and not enough time cutting metal. He responded with a great story told to him by Burt Rutan, who said that, there were originally three Wright brothers working on the Wright flier. The third brother whom we haven't heard of, was a structural analyst and he is still working on the analysis of the Wright Flier. It was an amusing anecdote but one that cuts to the chase of something close to Tim's heart, which is fast prototyping and testing. Something that he feels helped him close the recent contract with the Boeing team for the Ares I Rocket upper stage.

So what of the future? Orion has gone from a small start up company, formed in 2004 on the back of the success of the SpaceShipOne engine, to now being a part of the Boeing Ares I Upper Stage Production Group. Orion will be supplying thrusters and thruster modules for the upper stage, which is unprecedented for a small company only in business for three years. Tim puts it down to working lean and mean. Getting things done quickly and efficiently. "We received a contract to support what we needed to do, just in order to anticipate the Upper Stage Production Program. We had to produce a facility plan, a production plan for the fabrication of ValveTech thrusters and also show implementation of our quality systems. We had to have a staffing plan, an installation of AS 9100 Quality Systems and a Hydrazine test facility. We achieved all of these milestones in less than three months," he states with some pride.

The thruster and thruster module work for Orion should be a multi-millions of dollars contract over the 7 contract years. This will involve substantial expansion of the company's facilities around Huntsville and will hopefully make it one of NASA's preferred suppliers.

So now the High Powered Rocketry buff gets to sit at the big table, building real flight hardware for America's new moon rocket. It just goes to show that, if you persevere, anything is possible in the pursuit of a dream -- no matter how high you aim.