

## Local rocket science goes for the moon

By Laura Petersen

Watering one's garden with a liquid oxygen nozzle may seem a little strange. A little... unreasonable.

Such oddities make perfect sense to engineer Paul T. Breed, who is safely testing equipment for the rocket he is building with his son Paul A. Breed, 20, in their Solana Beach garage.

"Being reasonable is no fun," Breed Jr. said. "Being normal is no fun."

The father-son team is competing in the Northrop Grumman Lunar Lander Challenge, a \$2 million competition requiring a vehicle to simulate trips between the moon's surface and lunar orbit. The NASA-sponsored competition will take place Oct. 27 to 28 during the Wirefly X Prize Cup at Holloman Air Force Base in New Mexico.

The name of the Breed's entry: Unreasonable Rocket.

The rocketeers are inspired by playwright George Bernard Shaw who said: "Reasonable people adapt themselves to the world. Unreasonable people attempt to adapt the world to themselves. All progress, therefore, depends on unreasonable people."

While hardly aerospace engineers a year ago, building a powerful rocket that could advance lunar spaceflight didn't seem an unreasonable undertaking to the Breeds.

"I was helping the San Diego State University rocket team with telemetry (wireless measurement reporting)," said Breed Sr., who founded Net Burner, an embedded computer systems engineering company. "I thought it didn't look that hard."

The Lunar Lander Challenge requires a rocket to take off from a designated launch area, fly straight up 50 meters, hover 180 seconds while traveling to a landing pad 100 meters away, land precisely on the pad, and then repeat the flight in reverse.

After watching the contest last October, in which one team almost completed the task, the Breeds set to work.

Their rocket is a pyramid design: four identical sets of aluminum fuel tanks angle toward a center point, connected by carbon fiber tubes and cushioned by shock-absorbing landing pads. A 250-pound-thrust motor is attached to each set of tanks. A 50-pound payload and electronics control box sit on top.

"Three points stabilize the plane, with four the math is easier," explained Breed Jr., who attended Illinois Institute of Technology for a year before moving to California with his family. He is studying at Mira Costa Community College with plans to transfer to UC San Diego.

To power the rocket, the Breeds are using the same combination of fuel used in the first rocket launched into space, the German V-2 ballistic missile — 50 percent ethanol and water mixture, 50 percent liquid oxygen pressurized by balloon-grade helium. When the two components combine



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Kids, don't try this at home. Paul T. and Paul A. Breed work on the Unreasonable Rocket in their garage.

in the motor and are lit by a spark plug, the internal combustion propels the rocket into the air, NA firing exhaust out the bottom of the motor.

The rocket's flight will be preprogrammed by an embedded computer, and tracked by a commercial GPS unit.

"Nothing we're doing here is earth-shattering technology," Breed Sr. said. "Other than it's being done by amateurs in a garage. That's one of the goals, to show two guys in a garage can actually build a significant rocketry project."

To be clear — nothing hazardous happens in the garage. All testing takes place four hours away at the Friends of Amateur Rocketry facility in the Mojave Desert.

The pyramid design enables the Breed's to test one quadrant anchored to a test platform, rather than the entire rocket, saving materials and money.

"Instead of spending \$2,500 testing a weekend, we spend \$500 to \$600," Breed Sr. said. "Rather than burning 20 pounds of copper on a failed test, we burn five pounds."

The team has been testing every other weekend since February. The first test came pretty close — 113 seconds towards the 180-second requirement. But it didn't always go well. Look up Unreasonable Rocket on YouTube and view several video clips of tests marred by a green flash, the telltale sign of melting copper.

"It's painful," Breed Sr. said of the trial

and error. "Especially, when you realize it takes eight hours to get there and back."

After tinkering with solder types, ignition timing and cooling procedures, the Breeds seem to have a functional rocket that runs 180 seconds. The next testing phases are: an 180 second burn with controlled throttle (the rocket runs longer when not on full throttle), an anchored 180 second burn with all four engines, hovering the rocket attached to a crane, and finally, free flying the rocket.

Flying a rocket requires an experimental flight permit from the Federal Aviation Administration, something not easily obtained. Breed's application is currently under review, but deemed substantially complete — a good sign.

"We'll be the smallest group to get clearance," Breed Sr. said. "No group smaller than 15 people has ever done that."

Unreasonable Rocket is up against some steep competition. Last year, four teams entered, but only one had a viable machine by the contest date — Armadillo Aerospace. Led by John Carmack, the software guru who designed the successful computer games "Quake" and "Doom," this team almost won with their rocket Pixel, but a broken landing leg proved an insurmountable roadblock. This year, nine teams have signed on for the competition. Armadillo Aerospace is favored to win. Whether the other teams make it to New Mexico with functional rockets remains to be seen.

Keep up to date on Unreasonable Rocket's progress at [www.unreasonablerocket.blogspot.org](http://www.unreasonablerocket.blogspot.org).

While Unreasonable Rocket has made significant progress, one year was a much tighter deadline than anticipated. The Breeds have spent every waking minute outside of work and school — often sacrificing sleep — working on the rocket.

"I'd say we have a 40 percent chance," Breed Sr. said. "There is so much to do and we're 86 days away."

If the Solana Beach team doesn't make it, they will keep working if the challenge is held next year. Either way, it's been an invaluable experience for the Breeds.

Nothing beats hands-on learning, and Breed Jr. can take these skills into his career of choice, on top of writing a killer college application essay.

For Breed Sr., applying free market enterprise to develop cost-effective space technology is participating in a revolution on par with the introduction of the printing press. It's providing access to the masses.

"If NASA ever gets back to the moon under NASA's power," Breed Sr. said, "some private organization will take the CNN reporters to film it."