

## SpaceDev Hybrid Propulsion

We are the world leader in non-explosive hybrid rocket propulsion. This unique technology is based on a combination of two non-explosive materials: nitrous oxide ( $N_2O$ ) as the oxidizer, and hydroxy-terminated polybutadiene (HTPB), or synthetic rubber as the fuel. The result is a propulsion technology that blends the simplicity of solid rockets with the restart and throttle ability of liquid-fueled propulsion.

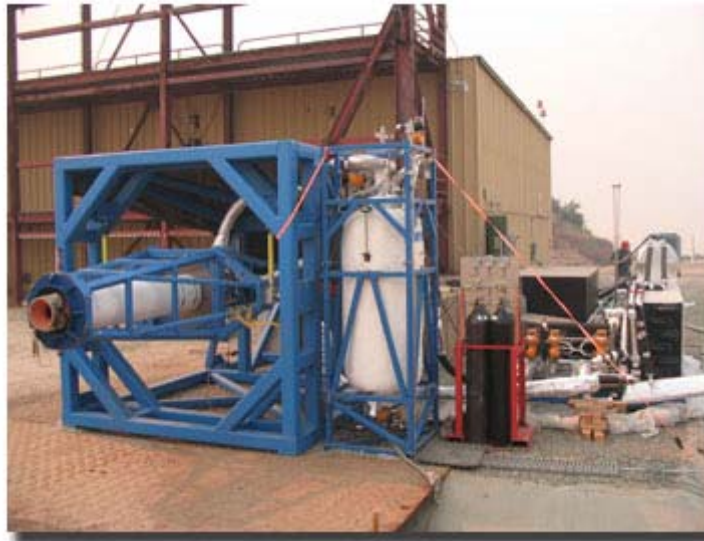
The most significant aspect is that hybrid rockets are non-explosive. Vandenberg Air Force Base rates hybrid rockets as having "zero-lb" equivalent explosive energy. The inability to detonate makes it particularly well suited for human spaceflight and for applications that require a non-explosive propulsion technology that can be safely transported and handled without special precautions. Pioneered by the AMROC Corporation, we acquired the exclusive rights to the AMROC technology in 1998 and has continued its development and application.



### Capistrano Test Facilities

The Capistrano test site is our Space Technology Development Center (STDC), located within the Northrop Grumman Capistrano Test Facility. The site comprises a thrust stand, operations trailer, fire suppression system, fluid storage and delivery system, and data recording system. Initially sized to

meet the needs of the HUS program, the facility will eventually be upgraded to accommodate firing hybrid motors with up to 250,000 lb of thrust.



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### **SpaceDev Hybrid Propulsion Programs**

#### **SpaceShipOne**

SpaceDev was chosen as the exclusive provider of critical hybrid propulsion components and integrator of the rocket motor for the revolutionary manned SpaceShipOne. We provided the fuel grains, key operating hardware, and electronics for the hybrid motor. More than 15 motors were provided for the SpaceShipOne program, some providing over 12,000lbs of thrust for more than 60 seconds.

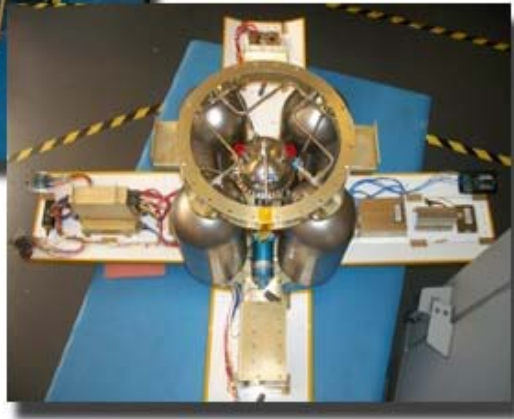
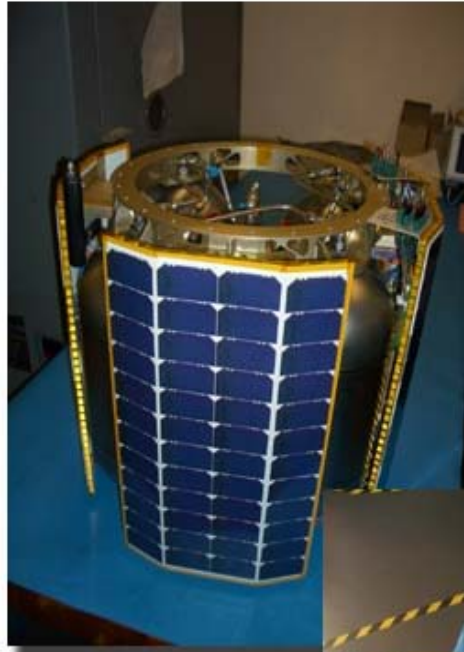
Paul Allen's SpaceShipOne won the worldwide Ansari X-Prize on October 4, 2004, a \$10-million purse to be awarded to the first vehicle team to fly a privately-funded sub-orbital spaceship 100 km (62 miles) to space, return safely, and then fly again within two weeks. The piloted spaceship was capable of carrying three individuals.



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### **Maneuver and orbital Transfer Vehicle (MoTV)**

We have developed a Shuttle-compatible propulsion module for the Air Force Research Lab (AFRL) and a more complete “space tug” using hybrid motors. Our MoTV was designed to provide on-orbit maneuvering and orbit transfers of customer microsattellites and payloads launched from expendable launch vehicles. The throttle-ability and simplicity of the hybrid technology makes it a uniquely capable technology for orbital transfer.





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### **SpaceDev Dream Chaser™**

The sub-orbital and orbital SpaceDev Dream Chaser™ is derived from an existing NASA HL-20 design and will have a sub-orbital altitude goal of approximately 160 km (about 100 miles), an orbital goal of 420 km (about 200 miles) and will be powered by our hybrid rocket motors. Our Dream Chaser™ hybrid motor will produce approximately 100,000 pounds of thrust—about six times the thrust of the SpaceShipOne motor.

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### **Hybrid Upper Stage**

Under the Hybrid Upper Stage, or HUS, program, SpaceDev developed, built, and fired several heavy motor test articles of a small launch vehicle upper stage. Sponsored by AFRL under their Small Launch Vehicle SBIR, five HUS motors were tested at our Space Technology Development Center, located at the Northrop Grumman Capistrano Test Facility.



### **Additional Information**

**Hybrid Rocket Propulsion Systems**

**MoTV (orbital Maneuvering and Transfer Vehicle)**

**SpaceDev's clients have included:**

- National Aeronautics and Space Administration (NASA)
- Missile Defense Agency (MDA)
- DARPA
- Andrews Space & Technology
- Air Force Research Laboratory (AFRL)
- The Boeing Company
- Jet Propulsion Laboratory (JPL)
- Lockheed Martin
- Scaled Composites
- University of California, Berkeley (UCB)
- California Space Authority (CSA)
- Ball Aerospace and Technology Corporation
- Raytheon
- Northrop Grumman
- Lockheed Martin
- ITT
- Harris Corporation
- ATK
- Loral Space and Communication
- General Dynamics
- MacDonald Dettwiler
- Honeywell
- Orbital Science Corporation
- Hamilton Sundstrand
- Goddard Space Flight Center