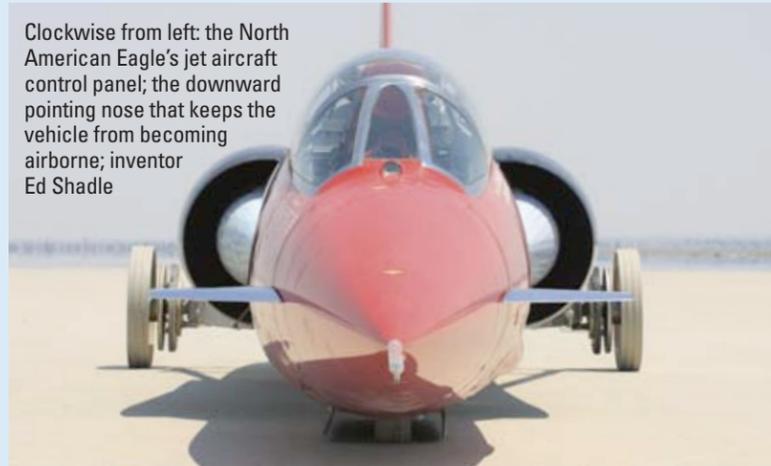




Clockwise from left: the North American Eagle's jet aircraft control panel; the downward pointing nose that keeps the vehicle from becoming airborne; inventor Ed Shadle



Will a U.S. race car become the fastest land vehicle this summer?

NEED FOR SPEED

By Bobby Oerzen

This July 4, a crowd of spectators will gather in a Nevada desert, hoping to witness history in the making. There the North American Eagle will attempt to set the world's land speed record.

The Eagle is a jet-race car hybrid—a Lockheed F-104 Starfighter attack jet converted into a sleek land speed racer. A British vehicle, the ThrustSSC, has held the land speed record (763 miles per hour [mph]) since 1997. On July 4, Team Eagle will attempt to bury that record with a blistering 800 mph ride.

TEAM EAGLE

The attempt got its start more than a decade ago when Ed Shadle and Keith Zanghi purchased an old fighter jet from the U.S. military. Shadle is a retired IBM project manager, and Zanghi a manager at Boeing aircraft. The two saw in that rusty hunk of junk the bones of a land speed racer.

A team of more than 40 volunteers has worked on the craft since then. "These are ordinary people doing extraordinary things," says Shadle. Team Eagle replaced most of the aircraft's body and upgraded almost everything else. Now, with a turbo-jet engine, custom-made aluminum wheels, and an onboard computer network, only one thing can slow

down the Eagle: the physics of resistance.

The first form of resistance is *inertia*. Inertia is the resistance of an object to a change in its motion. Because the Eagle weighs 5,897 kilograms (13,000 pounds), it needs a lot of *thrust* (forward force) to overcome its inertia.

The Eagle's jet engine supplies ample thrust, pushing the vehicle with 52,000 horsepower. (A 2009 Honda Civic has 140 horsepower.) That kind of thrust provides a long, stiff jolt. "It gets your attention!" laughs Shadle, the Eagle's driver.

As the vehicle accelerates, it encounters a second form of resistance: *friction*, a force that opposes motion. Friction occurs wherever two surfaces rub against each other. The smoother the surfaces, the less friction exists between them. That's why the Eagle runs on a \$100,000 set of slick, custom-made aluminum wheels. It's also why the vehicle is tested in Nevada's Black Rock Desert—"some of the flattest real estate in the world," says Shadle.

AIR PRESSURE

Another factor to consider when going for the land speed record is air. Air moving *perpendicular* (at right angles) to a fast-moving car can exert an upward force—*lift*—that could send the North American

Eagle airborne. "You want to design these cars so they're stuck to the ground," cautions Diandra Leslie-Pelecky, a physicist at the University of Texas. Earlier this year, NASCAR driver Ryan Newman got an unexpected "lift" when his car shot into the air.

If the Eagle lifts off the ground, that disqualifies it from the land speed record. To counter lift, the vehicle's design increases *downforce*, a downward pressure created by the aerodynamic characteristics of the car that increases the grip of its wheels on the ground. Those characteristics include horizontal fins, a downward pointing nose, and an unequal distribution of weight, with more at the front. The Eagle's engine is also angled downward so that the thrust itself increases the downforce. Those help push the Eagle not only well beyond anyone's expectations of a car, but well beyond the sound barrier.

MAKING WAVES

If the Eagle hits 800 mph, it will surpass the speed of sound. At sea level, sound travels at about 761 mph, and so far the ThrustSSC is the only ground vehicle that has ever reached supersonic speed.

Traveling at supersonic speeds is dangerous because a vehicle moving through the air emits sound waves, some of which fan out in

front of it. As the vehicle approaches the speed of sound, the sound waves bunch up and merge into an extremely powerful shock wave. When the vehicle surpasses the speed of sound, it breaks through the shock wave, making a loud, cracking explosion—a *sonic boom*. Before the ThrustSSC broke the sound barrier, its team feared the car might be torn to bits "like it were put through an office shredder," says owner Richard Noble.

To withstand sonic booms, the Eagle has a long, slender shape that increases the distance between the front and back wheels, giving the vehicle added stability. A long, vertical tail fin enhances that stability, balancing the car as the air flows over it the way a rudder does on a boat. If a gust of air tips the car too far in one direction, the tail fin props the vehicle back upright.

Should spectators hear the crack of a sonic boom this summer, they'll know the Eagle is on the verge of shattering the land speed record. "Since the sound is behind me, I'll only hear a faint shrieking," says Shadle. "The spectators will hear all the cool noises."

Spectators will get more than that, according to Leslie-Pelecky. "The North American Eagle changes the public image. It makes us see cars in a whole new way," she says. "It makes heroes out of scientists." **CS**

Counterforces

Several forces act on the Eagle, competing to push it forward (thrust), slow it down (friction), lift it into the air (lift), and hold it to the ground (downforce).

