# Case Study: GPS Tagging and Tracking System for Law Enforcement

**Client:** Developer of law enforcement GPS tagging and tracking equipment

**Client Problem:** Needed to develop a compressed air propulsion launching system and self adhering projectile for tagging vehicles with a GPS tracking device used on police vehicles to avoid high speed chases. The launcher must provide a laser for targeting and elevation control for aiming the projectile. It must be self contained and work in all weather environments. The projectile must avoid target recoil and securely adhere to the target.

**GEOMETRIXDESIGN Solution:** Design a single unit, dual barrel, compact launcher that uses valve activated compressed air to propel a cylindrical projectile from a moving vehicle with stability, accuracy, and velocity a sufficient distance to reach a moving target and design a projectile that carries a GPS tag that has balanced and stable flight and provides "dead contact" and adhesion to the target.

**Design Details:** The launcher was designed with a base frame that is mounted to the vehicle to provide a pivot and elevation support for the launcher body. Sheet metal was used for the base frame and launcher body for ease and cost in fabrication. The launcher pivot allowed up/down elevation adjustment using a stepper motor with screw fixed to the base frame.

The two barrels for loading and launching the projectiles were made from Delrin, a polymer instead of metal, to allow an active GPS satellite connection from the projectiles in the barrels. Delrin has high tensile strength, creep resistance, and low moisture absorption, so it is an excellent replacement for metal.

The barrels were mounted to a back plate that directed the compressed air into the center of the barrel for propelling the projectiles. Two valves mounted into the back plate below the barrels provided the release of the high pressure air to impact the back of the projectiles.

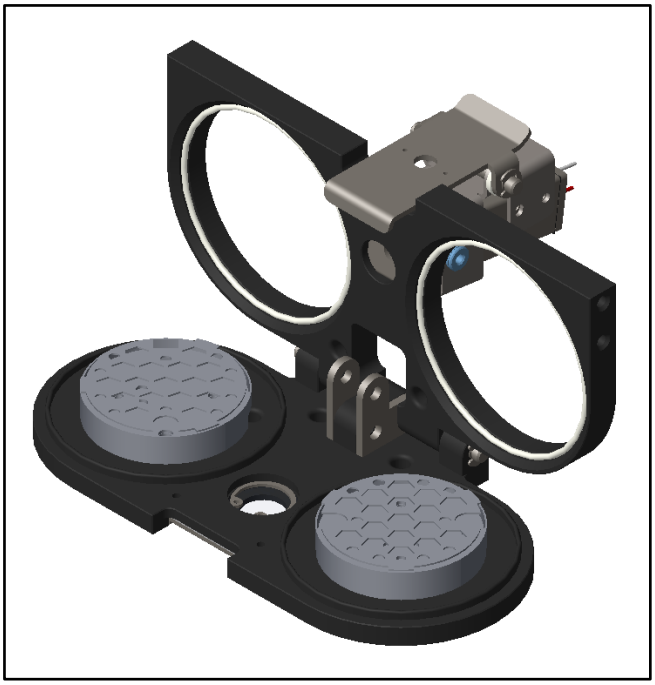
**Compressed air GPS projector launcher with dual barrels**

To protect the projectiles inside the barrel during vehicle patrols, a flip-up door covers both barrels. A smaller air valve mounted in the center of the back plate powers an air cylinder to activate the door opening. The door opens at a fast rate just prior to projectile launch and closes quickly to seal the barrels. A latch below the door secures the door from unauthorized opening and is release only when the launcher is in active firing mode.

To allow targeting of the launcher, a green laser is mounted between the barrels and emanates through a window in the door. The green laser light helps guide the elevation of the launcher to ensure projectile contact to the target depending on distance and speed.

The projectile is cylindrical in shape and houses a GPS tag. The projectile must achieve three main purposes: have steady flight when fired from the launcher at all

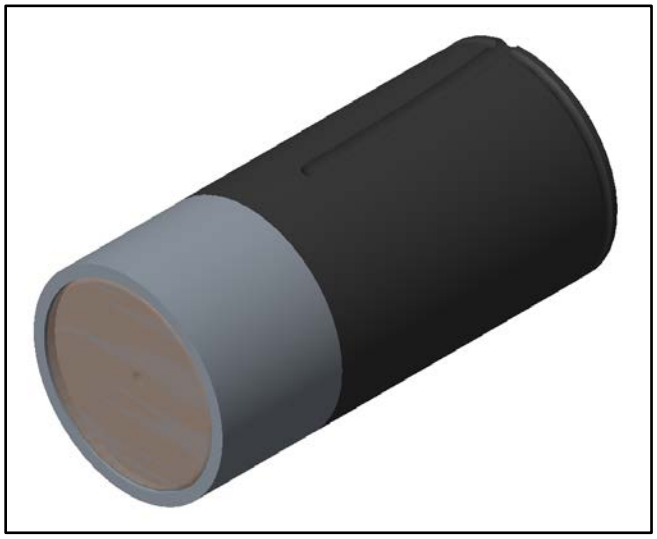
vehicle speeds and over a distance of up to 30 feet; contact the target (back of a moving vehicle) without rebound (no bounce back); and securely adhere to the target to provide the necessary GPS tagging.



**Open barrel door assembly (inverted) showing the projectile adhesive heaters, latch, and laser**

To obtain the steady flight, the projectile was designed to spin along its central axis. A slight helical groove along the outside of the Delrin projectile body is fitted against a pin in the barrel. Upon firing, the projectile is automatically forced into axial rotation providing the spin for stable flight.The front of the projectile was fitted with an aluminum foam nose pad that collapses when contacting the target which sharply deadens the impact resulting in zero recoil.

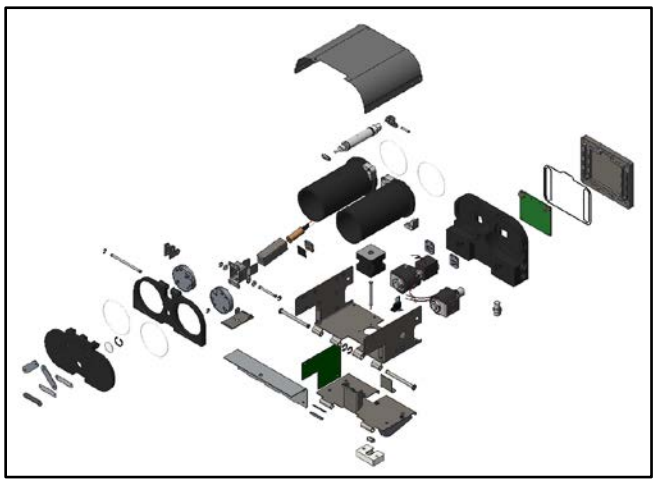
A heat activated, very high strength adhesive is dispensed in a thick layer onto the front of the aluminum foam nose pad. The adhesive has a fast cure rate that bonds to the target and requires high force for removal. To heat the adhesive prior to firing a projectile, two electric heaters were mounted on the inside of the launcher door in the barrels ahead of the projectiles. The heater circuit is activated when the launcher is armed and the adhesive is quickly brought to its melting temperature. A thermocouple was fitted into the adhesive through the projectile to monitor its temperature.



**Model of projectile showing slight helical groove, aluminum foam nose pad, and bonding adhesive**

The interface between the projectile and launcher is achieved through the back plate of the projectile. A ringed circuit board fits against a set of spring pins in the launcher to provide the signals for the GPS codes and thermocouple voltage.

This launcher/projectile system has a very high target hit rate with a single firing. In the event that projectile fails to successfully tag the moving vehicle, a second projectile is available in the launcher.



**Launcher exploded view showing the extent of the components and overall design**

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