

## Introduction

With energy and environmental concerns mounting as global energy demand increases, alternative fuels for vehicles are drawing more and more attention. Natural gas is one such alternative that could help alleviate dependence on foreign oil. However, the major shortcoming of natural gas is that it must be highly compressed in order to be stored at a comparable energy density to liquid fuels.

### Why Natural Gas?

Natural gas (methane) is an attractive alternative fuel for a number of reasons. It is extremely clean-burning compared with oil-based fuels like gasoline, which generate harmful emissions, causing pollution and contributing to the “green-house effect.” Natural gas is also readily available in much of the world.

### What Is ANG?

Natural gas could possibly be put to work to efficiently fuel vehicles through the use of adsorbed natural gas (ANG) technology. This technology allows natural gas to be adsorbed by a porous adsorbent material at relatively low pressures, around 500 psig (3.4 MPa). As a comparison, in current natural gas-powered vehicles (NGV), the gas is stored in a compressed natural gas (CNG) tank at approximately 3,000 psig (20 MPa). This new carbon adsorbent was developed by researchers at the University of Missouri-Columbia and is in the form of a briquette (somewhat like charcoal) inserted in the new fuel tank.

The new adsorbent must now be tested to determine its adsorption capability. Thus, a test tank assembly (Figure 1) has been conceived and is being built at Midwest Research Institute (MRI) to ascertain the adsorbent’s capability.

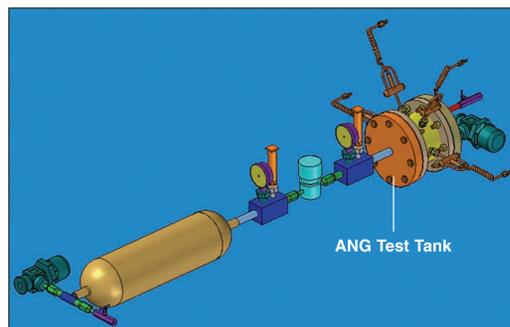


Figure 1. Test tank assembly

## Objective

The Alliance for Collaborative Research in Alternative Fuel Technology (ALL-CRAFT) is a partnership of academic research institutions, private-sector R&D companies, and government institutions working together to develop low-pressure, high-capacity storage technologies for natural gas. MRI, an ALL-CRAFT partner, is assigned the task of developing a fuel tank and fuel delivery system for an NGV modified to store the natural gas using ANG technology. MRI’s designs in this first phase of the project, scheduled for completion in 2006, should be regarded as provisional.

## Methods

So far, the main tasks have been creating a concept model and solved the logistics of modifying the vehicle’s fuel delivery system to accommodate the use of the ANG tank in addition to the pre-existing CNG tank. Such logistics include optimizing space usage and incorporating a CPU to control the flow of fuel. Additionally, mechanical design analyses were performed to assure safe operation at the working pressures.

## Design

The fuel system of a 2005 Honda Civic GX will be modified by installing an ANG fuel tank to serve as an auxiliary tank to the existing, higher-pressure CNG tank. The vehicle will have additional capabilities while maintaining all of its original functions. One such capability is running either from its CNG or ANG tank, with an emphasis on maximizing ANG tank use. Moreover, the CNG tank will be equipped to simultaneously fuel the engine and refill the ANG tank upon the latter’s depletion. A simplified schematic of the proposed fuel delivery system is shown in Figure 2.

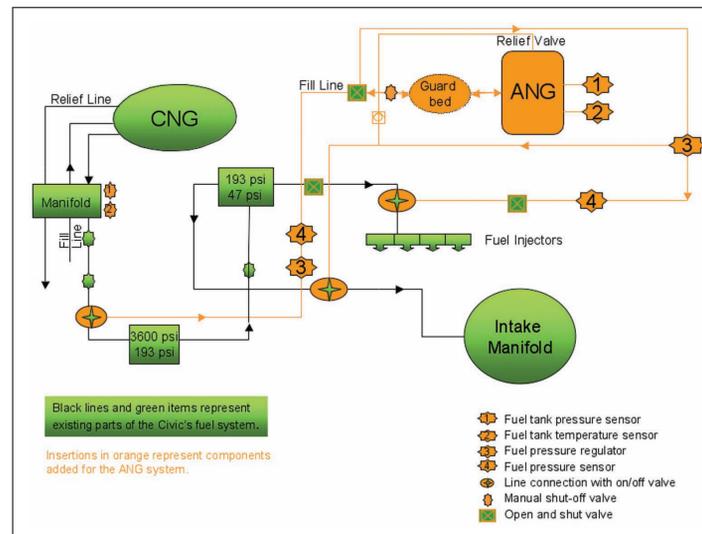


Figure 2. Proposed fuel delivery system

### On-Board CPU

An on-board CPU will be installed to control this modified fuel delivery system and record data such as mileage accrued from each tank. Designs of the computer functions were developed for the purposes of recording data like travel time, pressure, and temperature for analysis. The flow chart in Figure 3 demonstrates the computer’s operations.

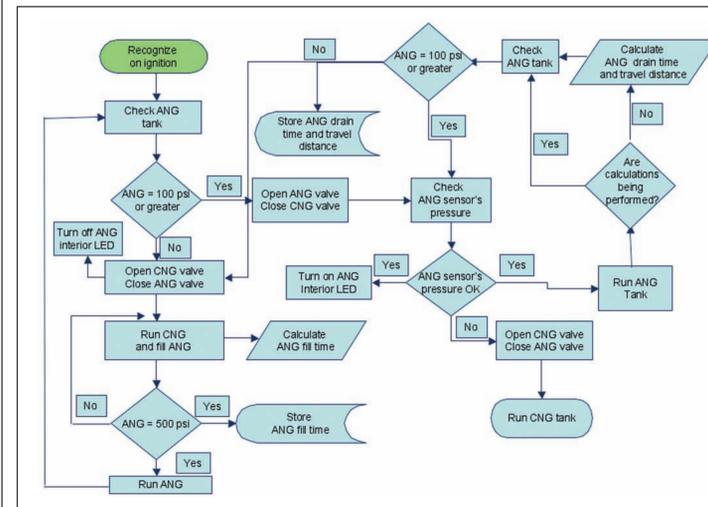


Figure 3. Computer operations for fuel delivery system.

### Tank Geometry

The ANG tank will have a cylindrical design, a characteristic of conventional pressure vessels. (One of the original ALL-CRAFT goals of developing a “flat-panel” fuel tank for a vehicle was abandoned for financial reasons and for design and manufacture convenience.)

### Tank Location

Location and mounting of the ANG tank and its supporting equipment must be carefully considered as space is at a premium in the compact Civic GX. The tank is designed to sit in the trunk, in front of the CNG tank, as shown in Figures 4 and 5. This placement avoids infringement on the passenger volume and efficiently uses what little trunk space is available. However, future discussions concerning the safety of such placement could lead to a different layout.

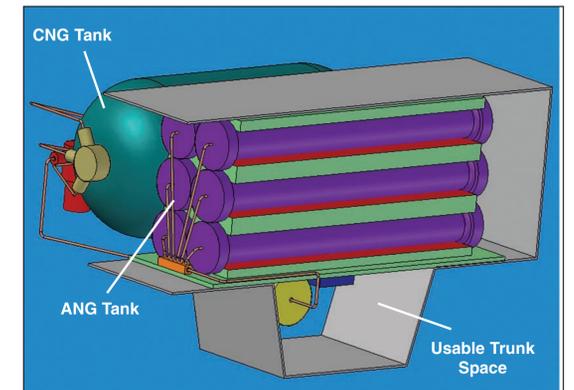


Figure 4. ANG tank assembly placed within the usable trunk space.

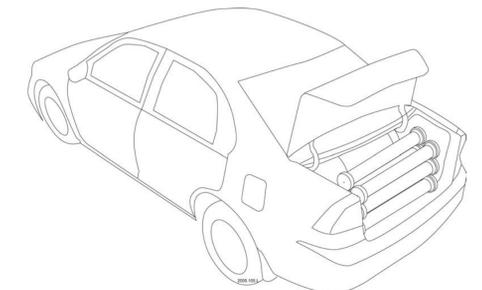


Figure 5. ANG tank assembly in Civic trunk.

## Conclusion

Natural gas certainly could gain more attention in the motor fuel market if oil prices continue to rise. However, for ANG technology to be practical in the marketplace, an adsorbent of greater capacity must be developed in order to compete with gasoline and diesel. ALL-CRAFT adsorbent researchers at the University of Missouri-Columbia are developing a solution to remove this roadblock on the highway to clean air.

## Acknowledgments

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