Clean, Efficient Propane Engines for Irrigation

Technology Fact Sheet

Residential | **Agriculture** | Industrial/ Commercial | Engine Fuel | R&D

Irrigation is an energy-intensive farming operation. Due to the substantial rise in the cost of gasoline and diesel in recent years, growers are exploring alternative fuels and taking steps to upgrade the overall efficiency of their irrigation systems.

Advanced propane-fueled stationary irrigation engines offer increased efficiency and reliability with reduced maintenance needs. Achieving Environmental Protection Agency and California Air Resources Board certification for the GM 5.7-liter and Ford 4.0-liter irrigation engines ensures that this cost-effective and efficient equipment can be sold to growers nationwide.

The total energy expenses for on-farm pumping of irrigation water reached $2.68 billion in 2008 – a 73 percent increase since 2003.
–Table 20, 2008 USDA Farm and Ranch Irrigation Survey

Current Status: Commercialization Phase

Research | Development and Testing | Demonstration | **Commercialization**

- The GM 5.7-liter Vortec Powertrain engine received EPA and CARB emissions certification in 2009.
- The EPA and CARB emissions certification of the Ford 4.0-liter engine for model years 2010 through 2015 is expected in 2010.

Technology Features

- 4.0-liter six-cylinder and 5.7-liter eight-cylinder large spark ignited engines.
- Dry fuel valve train.
- Intake/exhaust manifolds and exhaust catalyst.
- Hydraulic roller lifter camshaft.
- Induction-hardened inlet valve seats.

Propane Irrigation Engines: Key Benefits

- Produce 24 percent fewer emissions, on average, than comparable gasoline irrigation engines.
- Consume up to 6,000 gallons of propane per year, for each GM 5.7-liter irrigation engine sold.
- Eligible for sale in all 50 states following EPA and CARB emissions certification.
- Reduce irrigation engine maintenance costs by decreasing deposits on engine components.
- Consume up to 4,000 gallons of propane per year, for each Ford 4.0-liter irrigation engine sold.
- Ensure reliable irrigation without grid-related power interruptions.

For more information on this and other research projects, go to www.propanetechnology.com.

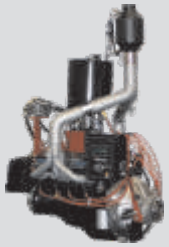
PROPANE EXCEPTIONAL ENERGY®

A Closer Look

Engine Uses Extend Beyond Irrigation

Spark ignited stationary engines like the Ford 4.0-liter and GM 5.7-liter engines can be used in irrigation pumps and other industrial applications such as air compressors, wood chippers, aerial lifts and other harvest equipment, prime and backup generators, skid steer loaders, and wind machines.

In July 2008, EPA mandated that all new or reconstructed propane-fueled engines sold in the United States must be emissions certified. PERC and engine manufacturers responded to this regulation to ensure continued use of these reliable, powerful, efficient engines in the full range of applications.



GM 5.7-liter engine

Ford 4.0-liter engine

Projects:	U.S. EPA Certification of the GM 5.7L Stationary LPG Engine **(Docket 15667)** EPA and CARB Certification of Ford 4.0L Industrial Engine **(Docket 16081)**
Partners:	Buck's Engines; Woodward Governor Company; Electronic MicroSystems; Engine Distributors Inc.; and EControls Inc.

Research Process (✔ = completed; ➤ = in progress; ★ = upcoming)

Development ✔

- Select fuel system and catalyst.
- Design and build prototype engines.

Testing and Certification: GM 5.7-liter Engine ✔

- Conduct laboratory and field testing, including a large spark ignited transient test and a C2 steady state modal test on propane fuel. Measure nitrogen oxides, carbon monoxide, and total hydrocarbons in a proportional bag sample of the diluted exhaust.
- Compile emissions, performance, fuel consumption, and power data and submit information to EPA and CARB.
- Receive EPA Certificate of Authority and CARB Executive Order certifying the engine for off-road use.

Testing and Certification: Ford 4.0-liter Engine ➤

- Conduct laboratory testing to collect emissions, performance, fuel consumption, and power data. Testing includes those tests required for propane-fueled engines used as a variable-speed mobile source and on propane as a constant speed stationary engine as regulated under Title 40 of the *Code of Federal Regulations*, Parts 60, 1048, and 1065.
- Submit emissions data to EPA and CARB; achieve EPA and CARB emissions certification.

Commercialization: GM 5.7-liter Engine ➤

- Market and sell the certified engine in all 50 states. Marketing plan includes website listings with search engine optimization, dealer training, and distribution of printed brochures and displays at agriculture trade shows.

Commercialization: Ford 4.0-liter engine ★

- Market the engine to industry and through the Engine Distributors Inc. network of dealers.

What's Next?

The GM 5.7-liter engine is commercially available. Commercialization of the Ford 4.0-liter is expected sometime in 2010.

FOR MORE INFORMATION:

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