

## Reducing Emissions

from Large Four-Cycle Gas Engines with Woodward SOGAV™ Technology

Eight years ago, a major pipeline operating company applied the best reduction technology available at the time to a four-stroke compressor station engine in response to state clean air regulations. That technology successfully reduced NOx emissions from the engine by about 90%, to a level of 2–3 g/bhp-hr.

Recently, however, new regulations required the engine emissions be reduced by another 60%, to a level of 1.1 g/bhp-hr. The pipeline company approached DigiCon, Inc., of Craley, PA, to present an engineered solution for the additional NOx reduction.



DigiCon responded with a modification to the fuel system to change the fuel injection system from the standard thru-the-head direct in-cylinder injection design, to a low-pressure port fuel injection design. The new system incorporates one Woodward SOGAV™ admission valve on

each intake transition piece from the intake air header to each cylinder head.

The new system was able to reduce engine NOx emissions to below 1.0 g/bhp-hr, while simultaneously reducing fuel consumption another 5% over the previously installed technology.



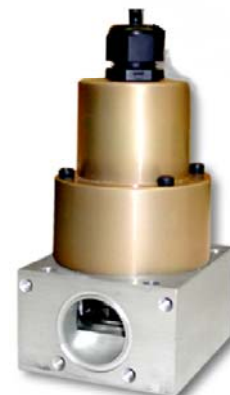
- Electronic fuel injection technology for four-stroke engines
- Port fuel admission for improved cylinder-to-cylinder control
- All-electric actuation
- Fast response
- Simple installation
- For new engines and retrofits
- Choice of sizes
- CSA Class I, Division 2, Groups A, B, C, D
- CE Compliant

### Application

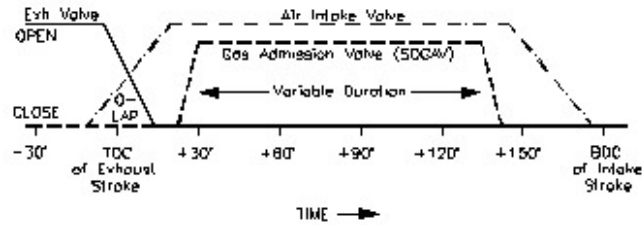
Used in mainline natural gas transmission service, the engine is required to run under various load and speed conditions. This requirement makes emission reduction more difficult, since the engine control system has to respond to the changing operating conditions with changes to the fuel injection quantity, fuel injection timing and air manifold pressure.

DigiCon's Aeros control system is able to evaluate the conditions and provide the proper injector control signal to keep the engine operating in compliance. In addition, the DigiCon Aeros fuel Injection system is able to balance the engine on a real-time basis by monitoring the peak firing pressure in every cylinder, and immediately adjusting the amount of fuel injected into each cylinder.

The system includes a HMI screen that enables the operator to visually see the balance of each cylinder as displayed on a bar chart, that compares the difference of each cylinder's peak pressure average to the overall engine's peak pressure average. An alarm is given if that average pressure exceeds a pre-set value, and the engine is shut down if a potentially damaging condition is detected.



The system serves as the engine governor by varying the time that the fuel valve is open in response to changes in engine load. As load increases, the duration that the fuel valve is open is increased in order to maintain the pre-set speed, and as load decreased, the time is decreased. This provides a very quick response to the engine, and speed is maintained within very narrow limits. The effect on the engine is a smoother running, more reliable machine.

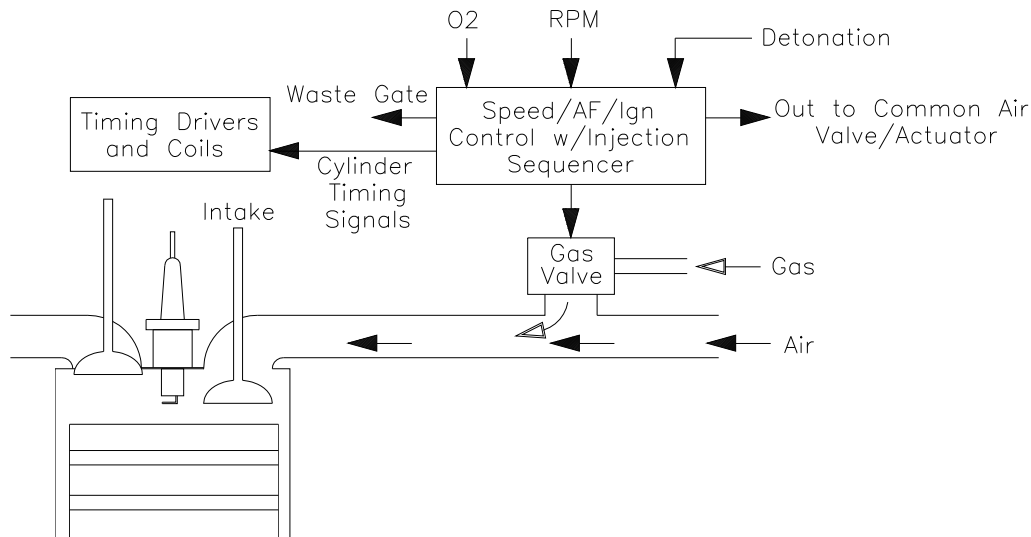


## ***The Woodward SOGAV™ Gas Admission Valve***

The Woodward SOGAV (Solenoid Operated Gas Admission Valve) is an electrically actuated, high response gas admission valve for in-manifold (port) fuel admission. The valve is designed for use on four-cycle, turbocharged, natural gas or dual-fuel engines, with one valve required for each cylinder.

The SOGAV valve's E-core solenoid has a short travel and high output force that results in fast and consistent opening and closing response. The valve is a face-type poppet with multiple concentric grooves. The moving metering plate is spring-loaded and pressure-loaded in the close direction.

The result is a port gas admission system that provides excellent cylinder-to-cylinder control and outstanding response. By controlling fuel flow into the cylinder precisely, the SOGAV allows the engine performance to be optimized for low emissions and high fuel efficiency.



PO Box 1519, Fort Collins CO 80522-1519, USA  
 1000 East Drake Road, Fort Collins CO 80525, USA  
 Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058  
 Email and Website—[www.woodward.com](http://www.woodward.com)

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