

CONTROLLING THE EMISSIONS OF RICH-BURN GAS ENGINES

For emissions compliance, new Continental Controls system designed for natural gas engines to 4000 hp

Continental Controls Corp., San Diego, Calif., has introduced a system designed to control the emissions of rich-burn natural gas engines up to about 4000 hp, to comply with increasing lower emissions levels.

Current emissions limits for natural gas engines in the Southern California coastal regions per hp/hr are 0.15 grams of NO_x, 0.6 grams of CO and 0.6 grams of HC. Many of the larger cities around the U.S. have adopted or are planning to use these same low levels as their standards.

Continental's Rick Fisher said these low levels of emissions can be met with rich-burn engine technology, a control system, an oxygen sensor and a three-way catalytic converter of sufficient size.

The components of the system include the Continental Controls ECV5 emissions control valve, a Zirconium Oxide O₂ sensor, a three-way catalytic converter, two type K thermocouples, and a computerized monitoring and display unit (TCA).

The Continental Controls ECV5 is a computerized valve that is designed to precisely control the fuel injection pressure to the carburetor or mixing bowl. The valve also functions as an electronic zero pressure regulator. The computer in the valve measures the voltage from the O₂ sensor located in the engine exhaust and adjusts the pressure at the valve discharge to maintain the proper air fuel ratio. The closed loop operation controls the fuel mixture, which is optimized for natural gas, and the catalytic converter.

The ECV5 is a full authority valve, and includes a very low range differential pressure sensor to measure the differential pressure between discharge pressure of the valve and the inlet pressure to the carburetor or mixing bowl. The range of the pressure transducer is -0.5 psid to +1.5 psid.

This differential pressure is sensed and compared to the internal pressure demand signal. Thus, Fisher said, the valve becomes a fast acting and precise pressure regulator that maintains the gas injection pressure even during speed and load changes. The supply pressure required at the inlet to the ECV5 is very low and depends on the fuel flow required and turbo boost pressure for the application.

The Zirconium Oxide O₂ sensor provides a measure of the oxygen content in the exhaust, with the output voltage fed back to the computer in the valve. The O₂ sensor voltage is compared to a setpoint and a difference or error signal is generated. The error signal is the input to an integral controller in the valve software and is used to adjust the pressure regulator setpoint to control the oxygen content in the exhaust.

The oxygen sensor output, after a short warm-up period, will increase to about 800 millivolts if the mixture is slightly rich, meaning very little oxygen is present. This voltage will transition to a low value when the fuel pressure is reduced, causing the mixture to be leaner and excess oxygen to be present in the exhaust gas. The O₂ sensor does not function until it is heated by the exhaust gas. The valve detects when the sensor is operational and then permits the O₂ sensor output to trim the gas injection pressure.

Two type K (Chromel-Alumel) thermocouples are provided for measuring the pre-catalyst and post-catalyst temperatures. The pre-catalyst temperature will also indicate the temperature of the O₂ sensor. The reaction in the catalyst is exothermic and the discharge temperature is higher than the inlet temperature when the converter is working properly.

The temperature of the exhaust gas going into the catalyst should be above 900°F for best converter efficiency. The catalyst can be damaged if the temperature exceeds 1300°F.

The TCA control unit provides the user interface with the system. It also monitors the operation of the system and displays all data available. The TCA also provides the means for changing the setpoints for the starting pressure and certain control setpoints and selected parameters. Some of the adjustments are not available by the TCA without password authorization.

The TCA includes graphic display in the form of bar graphs with numeric values. The operation of the system is monitored by selecting one of the parameters; gas injection pressure and its setpoint; oxygen sensor voltage and its setpoint; valve position; and starting pressure. The TCA also is provided with a serial port for MOD-BUS communication with other control and data logging systems.

The system includes Johnson Matthey catalytic converters that are modular in design and featuring quick-release clamps.

In operation, when the ignition is turned on, the ECV5 is permitted to open. The ECV5 regulates the gas injection pressure to a programmed value for starting and warm-up. When the O₂ sensor warms up the valve computer determines the sensor is functioning, the injection pressure will be trimmed to optimize the emissions.

When the ignition is turned off, the valve closes. An exhaust analyzer should be used to monitor the emission level after the catalytic converter during the initial installation and set-up. The O₂ setpoint can be varied to find the best balance between O₂ and CO emissions and to verify that the engine and emissions control system meet the applicable requirements. ★

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Clean up Your Emissions.

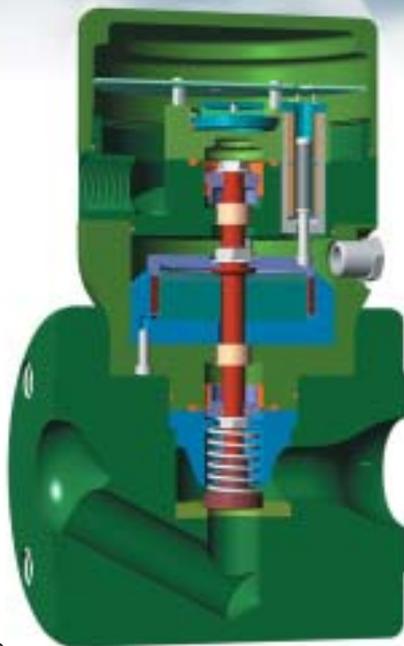


Meet tomorrow's emission control standards today.

When used with a Catalytic Reduction System, Continental Controls' ECV5 will provide the lowest achievable emissions from a natural gas engine. The ECV5 minimizes emissions by precisely controlling injection pressure with a bias from an O₂ sensor.

Maintain continuous emissions compliance even with changes in load or speed.

While other valves can optimize fuel mixture at specific loads and speeds, when either are changed, they can't maintain emissions compliance.



ECV5

Patent pending.

Simply the best available.

When used with a catalytic converter, the ECV5 minimizes NO_x, CO & HC emissions. The ECV5 normally eliminates the need for a separate low pressure regulator. The ECV5 is easily installed. Compare it to other systems on the market and you'll agree it's the best available control technology.

Make the ECV5 part of every natural gas engine package.

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