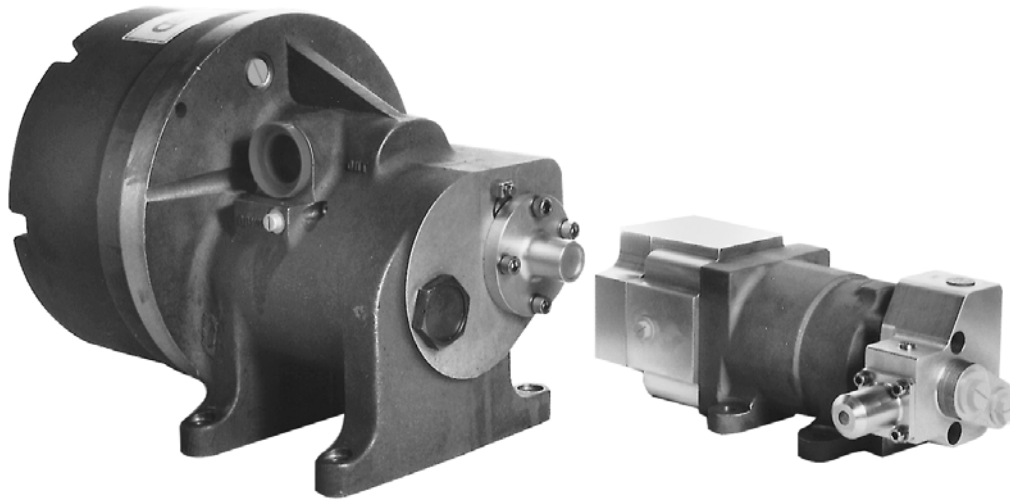


# LQ3 / LQ25

## Liquid Fuel Metering Valves

### Applications

**LQ25****LQ3**

Woodward's LQ series of liquid fuel metering valves are designed for use on industrial and aero-derivative gas turbine engines in the 1000 kW to 42 000 kW output power range. The assemblies provide reliable, cost-effective interfaces between electronic engine control systems and gas turbines used in power generation, mechanical drive, and marine applications. The LQ valves utilize corrosion-resistant, shear-type metering components that are positioned by high-torque actuators to assure extended operation in all types of liquid fuel service. The LQ valves are compatible with diesel fuels, JP series, kerosenes, gasolines, and other distillates conforming to nationally or internationally recognized standards for utility, marine and aviation gas turbine service.

### Description

Precise flow control is achieved by the use of a rotary plate valve integral with an electric actuator and a non-contacting position sensor. The use of rare earth permanent magnets in a highly efficient electromagnetic circuit minimizes package size. The integral brushless dc actuator and valve design eliminates the backlash associated with geared motors and avoids the resolution and cycle oscillation problems incurred with stepping motors. Each valve is supplied with a remote electronic interface unit (the LQ driver) which accepts a 4 to 20 mA position command signal and operates with an 18 to 32 Vdc power supply. This controller also provides a 4 to 20 mA output proportional to the actual valve position.

The LQ rotary plate valve achieves a self-cleaning, shear-type metering action. The valve metering sleeve is integral with the actuator rotor, resulting in fuel metering with a single moving part. Optimal flow versus input signal characteristics is achieved on each valve by precision EDM manufacturing of the valve metering port. The LQ valves can achieve flow turn-down ratios in excess of 100 to 1.

- Contaminant resistant
- All-electric actuation
- Models are available with certification for North American Hazardous Locations
- Models are available compliant with the applicable CE Directives—ATEX, EMC, Pressure Equipment, and Machinery
- Vibration tolerant, wide temperature range
- Fast response
- No field adjustments or calibration
- Standard 4–20 mA interface
- Precision fuel metering
- Single terminal block wiring interface

### OPTIONAL LQ25 FEATURES:

- Pressurizing valve
- Integral high speed shutoff valve
- Digital driver

Each valve is supplied with a GS/LQ driver, which performs the following functions:

- Fast and accurate closed loop position control of the liquid metering valve in response to a 4 to 20 mA input command signal
- Valve position indication output signal (4 to 20 mA)
- Remote shut-down command input
- Valve/Driver Fault output

The GS/LQ driver may be located up to 100 meters from the valve assembly to avoid exposure to hazardous atmospheres and harsh environments.

Liquid fuel flow control is achieved by a combination of accurately scheduling the metering valve port area and regulating the differential pressure across the metering port. Factors such as fuel properties (such as specific gravity and viscosity), as well as fuel pressure and temperature all play a part in how accurate the flow metering will be. The LQ valves are designed such that the effect of these factors on flow metering is minimized as much as possible. The inclusion of the bypassing regulator allows the LQ valves to be used with positive displacement fuel pumps.

## Valve Sizes

The LQ product line includes two valve models each with optional metering port sizes.

### LQ3

The LQ3 valve is suitable for use on gas turbines in the 1000 to 6000 kW output power range, depending on available fuel properties and conditions. There are two port sizes for the LQ3: the 0.033 in<sup>2</sup> (21.3 mm<sup>2</sup>) port is designed for maximum fuel flows of 1000 to 2000 lb/h (454 to 907 kg/h), and the 0.067 in<sup>2</sup> (43.2 mm<sup>2</sup>) port is designed for maximum fuel flows of 2000 to 4000 lb/h (907 to 1814 kg/h). The minimum metered flow of the LQ3 is 80 lb/h (36 kg/h). These flows assume a specific gravity of 0.77. All materials of the LQ3 are corrosion resistant.

The LQ3 utilizes the same bypassing differential pressure regulator that is currently used in Woodward's 1907 Small Liquid Fuel Valve series. This design has years of excellent operation history.

### LQ25

The LQ25 valve is suitable for use on gas turbines in the 6000 to 42 000 kW output power range, depending on available fuel properties and conditions. There are three port sizes for the LQ25: the 0.1 in<sup>2</sup> (64.5 mm<sup>2</sup>) port is designed for maximum fuel flows of 4000 to 8000 lb/h (1814 to 3629 kg/h), the 0.2 in<sup>2</sup> (129.0 mm<sup>2</sup>) port is designed for maximum fuel flows of 8000 to 18 000 lb/h (3629 to 8165 kg/h), and the 0.3 in<sup>2</sup> (193.5 mm<sup>2</sup>) port is designed for maximum fuel flows of 18 000 to 26 000 lb/h (8165 to 11794 kg/h). The minimum metered flow of the LQ25 is 80 lb/h (36 kg/h). These flows assume a specific gravity of 0.77. All materials of the LQ25 are corrosion resistant, or protected against corrosion.

The LQ25 utilizes a patented single-stage droop-compensated differential pressure regulator. This regulator provides excellent flow metering accuracy and repeatability at virtually all inlet and outlet pressure and flow conditions.

### LQ25 Options

In addition to the base metering valve, the LQ25 has a pressurizing valve option and an integral, separately commandable shutoff valve option. The pressurizing valve increases the pressure downstream of the metering port (and therefore upstream of the metering port) to enable low flows to be accurately and predictably metered even at high pump bypass levels. The pressure downstream of the metering port is increased to either 100 psid (690 kPa) or 200 psid (1379 kPa) above the bypass pressure with the pressurizing valve, depending on valve designation.

The shutoff valve is designed to seal off fuel flow downstream to the engine in less than 0.100 second at all operating conditions. A separately commandable four-way, two-position solenoid valve is used in conjunction with the pressurizing valve described above to form the shutoff valve. The solenoid must be energized to run the gas turbine. If power is lost to the solenoid valve, fuel flow will be terminated. A position switch which indicates when the shutoff valve at closed position is provided with the shutoff valve option.

## LQ Valve Specifications

| PARAMETER                       | LQ3                                  | LQ25                                     |
|---------------------------------|--------------------------------------|--|
| Liquid flow range               | 80 to 4000 lb/h<br>(36 to 1814 kg/h) | 80 to 26 000 lb/h<br>(36 to 11 794 kg/h) |
| Maximum fuel inlet pressure     | 1200 psig (8274 kPa)                 | 1200 psig (8274 kPa)                     |
| Maximum fuel bypass pressure    | 100 psig (690 kPa)                   | 100 psig (690 kPa)                       |
| Regulated differential pressure | 40 psid (276 kPa) nominal            | 50 psid (345 kPa) nominal                |

|  |   |   |
|--|---|---|
| Fuel Type  | The valve is compatible with most types of diesels, kerosenes, gasolines, heavy and light distillates including naphtha, gas turbine fuels and fuel oils, and other liquid fuels such as biodiesel that are compatible with fluorocarbon (FKM) type elastomers and conform to international standards for utility, marine, and aviation gas turbine service. Ultra low sulfur diesels are also acceptable with proper lubricity additives. Other fuels such as ethanol or methanol may be acceptable with internal seal compound substitutions. Contact Woodward for these and other special fuel applications. |   |
| Fuel Viscosity   | Fuel viscosity must be between 0.5 and 12.0 centistokes.  |   |
| Fuel Cleanliness   | Liquid fuel must be filtered to limit particulate size to 20 µm or smaller. Water content must be limited to 0.1% by volume. Solids, sediment, and particulates must be limited to 1.0 mg per liter of fuel.  |   |
|  | <b>LQ3</b>  | <b>LQ25</b>   |
| Metering ports available <sup>1</sup> (max. area)                      | 0.033 in <sup>2</sup> (21.3 mm <sup>2</sup> )<br>0.067 in <sup>2</sup> (43.2 mm <sup>2</sup> )  | 0.1 in <sup>2</sup> (64.5 mm <sup>2</sup> )<br>0.2 in <sup>2</sup> (129.0 mm <sup>2</sup> )<br>0.3 in <sup>2</sup> (193.5 mm <sup>2</sup> ) |
| Liquid fuel inlet and ambient temperature                              | -18 to +217 °F (-28 to +103 °C)   |   |
| Accuracy (% of port area)  | ±5% or actual or ±0.5% of maximum (greatest of)   |   |
| Metering valve leakage   | < 80 lb/h at 70 psig P1 press.<br>(< 36 kg/h at 483 kPa P1 press.)  | < 80 lb/h at 600 psig P1 press.<br>(< 36 kg/h at 4137 kPa P1 press.)  |
| Shutoff valve leakage  | N/A   | Less than 0.5 cm <sup>3</sup> /minute<br>at 400 psig inlet pressure   |
| Flow shut-off valve response   | N/A   | Close < 0.100 second  |
| Metering valve full travel slew time<br>(closed loop position control) | < 0.100 second  | < 0.100 second  |
| Metering valve shut down slew time<br>(@ 24 Vdc to driver)             | < 50 ms   | < 50 ms   |
| Position loop bandwidth <sup>2</sup>                                   | 35 radians/second (typical)   | 35 radians/second (typical)   |
| Fuel connections <sup>3</sup>  | Inlet: SAE J1926/1: 7/8-14(-10)<br>Outlet: SAE J1926/1: 3/4-16(-08)<br>Bypass: SAE J1926/1: 1-1/16-12(-12)  | All ports:<br>SAE J1926/1: 1-5/8-12(-20)  |
| Overboard vent connection <sup>3</sup>                                 | SAE J1926/1: 7/16-20(-04)   | SAE J1926/1: 7/16-20(-04)   |
| Electrical connections   | 2X 1/2"-14 NPT for conduit  | 1X 1/2"-14 NPT for conduit<br>1X 3/4"-14 NPT for conduit  |
| Pressurizing valve cracking pressure                                   | N/A   | 200 psid (1379 kPa) (Pin-Pbypass)   |
| Assembly weight  | 28 lb (13 kg)   | 77 lb (35 kg)   |
| Vibration and shock  | Vibration per MIL-STD-810-C, procedure 1,<br>Table 514.2II, figure 514.2-2, curve J (5 g)<br>Shock per MIL-STD-810-C Method 516.2,<br>Procedure 1, 20 g, 11 ms, sawtooth wave form  |   |

<sup>1</sup>—Power ratings are based on typical diesel fuel with a lower heating value (LHV) of 18 400 BTU/ bm and a simple cycle gas turbine thermal efficiency of 30%. At 40% thermal efficiency and with typical liquid fuels, the LQ25 can fuel 50 000 kW+ engines.

<sup>2</sup>—The system dynamics are approximately second order. Bandwidth is determined by magnitude response at -6 dB, 24 Vdc to GS driver.

<sup>3</sup>—Fuel connection ports will accept fittings that interface with standard SAE J1926/1 and MS16142 straight-thread ports.

## Regulatory Compliance (Valves)

### European Compliance for CE Marking:

These listings are limited only to those units bearing the CE Marking.

|  |   |
|--|---|
| <b>Pressure Equipment Directive:</b>                       | Declared to the Pressure Equipment Directive 97/23/EC of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment.<br><b>LQ25:</b> Category II   |
| <b>ATEX – Potentially Explosive Atmospheres Directive:</b> | Declared to 94/9/EEC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.<br><b>LQ25 (Zone 1):</b> LCIE 03.ATEX.6090, Zone 1, Category 2 , Group II G, EEx d IIB 160 °C T3<br><b>LQ25 (Zone 2):</b> LCIE 03.ATEX.6138, Zone 2, Category 3 , Group II G, EEx nC IIC T3<br><b>LQ3*:</b> LCIE 03ATEX.6375 X, Zone 1, Category 2, Group II G, EEx d IIB T3 X |

\*Note: Use supply wire suitable for at least 90 °C and 10 °C above maximum fluid and ambient temperature.

### Other European Compliance:

Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking:

|                                      |   |
|--------------------------------------|---|
| <b>Machinery Directive:</b>          | <b>LQ3 and LQ25:</b> Compliant as a component with 98/37/EC COUNCIL DIRECTIVE of 23 July 1998 on the approximation of the laws of the Member States relating to machinery.                  |
| <b>Pressure Equipment Directive:</b> | <b>LQ3:</b> Compliant as "SEP" per Article 3.3 to Pressure Equipment Directive 97/23/EC of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment. |

### North American Compliance:

These listings are limited only to those units bearing the CSA agency identification.

|             |  |
|-------------|--|
| <b>CSA:</b> | <b>LQ25 and LQ3:</b> CSA Certified for Class I, Division 2, Groups A, B, C & D, T3C at 103 °C Ambient. For use in Canada and the United States.<br><b>LQ25 and LQ3:</b> CSA Certified for Class I, Division 1, Groups C & D, T3C at 103 °C Ambient. For use in Canada and the United States. |
|-------------|--|

## LQ Driver Specifications

|                                   |   |
|-----------------------------------|---|
| Supply voltage to driver          | 18 to 32 Vdc  |
| Maximum transient supply current  | 20.0 A for 0.20 second  |
| Normal steady state input current | < 2.4 A   |
| Electrical connection             | Via terminal blocks on driver assembly, stud for external ground<br>Maximum separation of valve & driver 100 meters   |
| Valve position command signal     | 4 to 20 mA current signal into 249 $\Omega$ impedance   |
| Valve indicated position signal   | 4 to 20 mA current signal into < 500 $\Omega$ impedance   |
| Shutdown/reset command            | Close contact to run, open to close valve   |
| System fault indication signal    | 1 Form C dry contact output   |
| Ambient temperature capability    | -5 to +154 °F (-20 to +68 °C)   |
| LQ driver dimensions              | 19.0 x 12.25 x 5.0 inches (483 x 311 x 127 mm)  |
| Fault detection capabilities      | Open or short circuit conditions within the valve assembly or wiring connections<br>Input signal in excess of 23.5 mA<br>Position loop error in excess of 5% of full scale for more than 0.250 second |
| Ingress Protection                | IP66 per EN60529<br>Regulatory Compliance (Drivers)   |

### European Compliance for CE Marking:

These listings are limited only to those units bearing the CE Marking.

**EMC Directive:** Declared to 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.

**ATEX – Potentially Explosive Atmospheres Directive:** Declared to 94/9/EEC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.  
DEMKO 02.ATEX.130944, Zone 2, Category 3, Group II G, EEx nL IIC T4  
DEMKO 02.ATEX.130945, Zone 1, Category 2, Group II G, EEx d IIB T4

### North American Compliance:

These listings are limited only to those units bearing the UL agency identification.

**UL:** UL Listed for Class I, Division 2, Groups A, B, C & D, T4 at 68 °C Ambient. For use in Canada and the United States.



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

#### Distributors & Service

Woodward has an international network of distributors and service facilities. For your nearest representative, call the Fort Collins plant or see the Worldwide Directory on our website.

This document is distributed for informational purposes only. It is not to be construed as creating or becoming part of any Woodward Governor Company contractual or warranty obligation unless expressly stated in a written sales contract.

© Woodward 1994, All Rights Reserved

For more information contact:

2008/8/Fort Collins