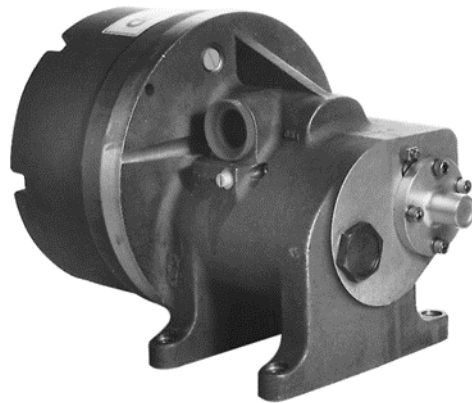


# LQ25

## Liquid Fuel Metering Valves

### Applications



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 fuel, JP series, kerosene, gasoline, 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 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 turndown ratios in excess of 100 to 1.

Each valve is supplied by a 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

- Contaminant resistant
- All-electric actuation
- Models are available with certification CSA, ATEX, and IECEx hazardous locations.
- Compliance with applicable CE Directives
- Stainless Steel models certified for use in marine applications
- Vibration tolerant, wide temperature range
- Fast response
- No field adjustments or calibration
- Standard 4–20 mA interface
- Precision fuel metering

### OPTIONAL LQ25 FEATURES:

- Pressurizing valve
- Integral high speed shutoff valve
- Integration with DVP driver
- Conduit or MIL connector interface

Models are available for plug-and-play installation with the Woodward Digital Valve Positioner (DVP). See specification 03376 for more information

The driver may be located up to 100 meters from the valve assembly to avoid exposure to hazardous atmospheres and harsh environments. However, driver models are available with hazardous location certifications.

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.

## ***LQ25 Valve Sizes***

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The following provides an overview of the LQ25 product line. For detailed information, see the following manuals:

<b>Manual</b>	<b>Enclosure Material</b>	<b>Resolver Feedback</b>	<b>Connection Type</b>
26161	Aluminum	Single	Conduit / Terminal Block
26475	Aluminum	Dual	Threaded Connector (MIL)
26854	SST	Single	Conduit / Terminal Block
35029	SST	Dual	Threaded Connector (MIL)

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)
- 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.

### **Options**

In addition to the base metering valve, the LQ25 has a pressurizing valve option and an integral, separately commanded 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 commanded 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.

The LQ25DR was developed specifically for plug-and-play use with the Woodward DVP driver featuring dual 3-speed resolvers and threaded connectors for easy installation.

Models compliant with marine regulations have a stainless steel valve housing and wetted components, instead of the standard aluminum design. These are available with all the options developed for the original aluminum valves.

## LQ25 Valve Specifications

PARAMETER	LQ25
Liquid flow range	80 to 26 000 lb/h (36 to 11 794 kg/h)
Maximum fuel inlet pressure	1200 psig (8274 kPa)
Maximum fuel bypass pressure	100 psig (690 kPa)
Regulated differential pressure	50 psid (345 kPa) nominal
Pressurizing valve cracking pressure	200 psid (1379 kPa) (Pin-Bypass)
Fuel Type	The valve is compatible with most types of diesel, kerosene, gasoline, heavy and light distillates including naphtha, gas turbine fuel and fuel oil, 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	0.50 to 12.0 Centistokes
Fuel Cleanliness	Liquid fuel must be filtered to limit particulate size to 20 $\mu$ m or smaller. Water and sediment must be limited to 0.1% by volume. Total particulate concentration must be limited to 2.64 mg per liter of fuel
Metering ports available <sup>1</sup> (max. area)	0.1 in <sup>2</sup> (64.5 mm <sup>2</sup> ), 0.2 in <sup>2</sup> (129.0 mm <sup>2</sup> ), 0.3 in <sup>2</sup> (193.5 mm <sup>2</sup> )
Fuel and Ambient Temperature	Aluminum: -18 to +217 °F (-28 to +103 °C) SST: -18 to +185 °F (-28 to +85 °C)
IP Rating (per IEC 60529)	IP66 (Conduit), IP64 (Connectors)
Accuracy (% of port area)	±5% or actual or ±0.5% of maximum (greatest of)
Metering valve leakage	< 80 lb/h at 600 psig P1 press. (< 36 kg/h at 4137 kPa P1 press.)
Shutoff valve leakage	Less than 0.5 cm <sup>3</sup> /minute at 400 psig inlet pressure
Metering valve full travel slew time (closed loop position control)	< 0.100 second
Metering valve shut down slew time (@ 24 Vdc to driver)	< 50 ms
Position loop bandwidth <sup>2</sup>	35 radians/second (typical)
Fuel connections <sup>3</sup>	All ports: SAE J1926/1: 1-5/8-12(-20)
Overboard vent connection <sup>3</sup>	SAE J1926/1: 7/16-20(-04)
Electrical connections	LQ25 / Aluminum / Conduit: 1X 1/2"-14 NPT and 1X 3/4"-14 NPT LQ25 / SST / Conduit: 2X 1/2"-14 NPT and 2X 3/4"-14 NPT LQ25DR: Threaded Connectors (per MIL std. and others)
Compatible Driver Input Voltages	18-32 Vdc or 90-140 Vdc (depending on options)
Shutoff Valve (SOV) Rating	24 Vdc, 25W or 125 Vdc, 25W
Shutoff Position Switch Rating	250 Vac 60 Hz / 250 Vdc, 5A (Resistive Load Only)
Feedback to the driver	Frameless resolver, single or dual, 1-speed or 3-speed
Assembly weight	77 lb (35 kg) (Aluminum); 191 lb (86 kg) (SST)
Vibration and shock	Vibration per MIL-STD-810-C, procedure 1, Table 514.2II, figure 514.2-2, curve J (5 g) Shock per MIL-STD-810-C Method 516.2, 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/lbm 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 (LQ25)

(Listings are limited only to those units bearing the appropriate Marking or Agency Identification)

### European Compliance for CE Marking:

**EMC Directive:** 2014/30/EU (LQ25DR only)

**Pressure Equipment Directive:** 2014/68/EU. Category II.

**ATEX Directive:** 2014/34/EU

**LQ25 (Conduit):** Zone 1, Category 2, Group II G, Ex db IIB 160C (T3) Gb, ITS 15ATEX18363X

**LQ25 (all):** Zone 2, Category 3, Group II G, Ex nA nC IIC T3 X Gc, IP66 (Conduit) or IP64 (Connectors)

\*Note: See product manual(s) for Special Conditions of Safe Use.

### Other European Compliance:

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

**EMC Directive:** Not applicable to this product. Electromagnetically passive devices are excluded from the scope of the

2014/30/EU EMC Directive (non-LQ25DR only)

**Machinery Directive:** Compliant as a partly completed machinery per 2006/42/EC.

**ATEX Directive:** Exempt from the non-electrical portion of the ATEX Directive 2014/34/EU due to no potential ignition sources per EN 13463-1.

### Other International Compliance:

**IECEX:** Certified for use in explosive atmospheres per Certificate:

**LQ25 (Conduit):** Zone 1: IECEX ETL 15.0025X, Ex db IIB 160C (T3) Gb

**LQ25DR (Connectors / Aluminum only):** Zone 2: IECEX CSA.14.0055X Ex nA nC IIC T3 Gc

\*Note: See product manual(s) for Special Conditions of Safe Use.

### North American Compliance:

**CSA:** Certified for use in Canada and the United States per Certificate 1382287.

**LQ25 (Conduit):** Class I, Div 1 Groups C, D T3C at 103C (aluminum) or 85C (SST) ambient

**LQ25 (all):** Class I, Div. 2 Groups A, B, C, D T3C at 103C (aluminum) or 85C (SST) ambient

### Marine Compliance: (SST enclosures only)

Marine Type approval has been obtained on this product. Contact your sales representative for more information.

The product has type approval for:

<b>DNV-GL:</b>	DNV-GL Type Approval Location Classes: Temperature B, Humidity B, Vibration A, EMC N/A, Enclosure A as defined in DNV Standard for Certification 2.4 (2006).
<b>LR:</b>	Lloyds Type Approval Environmental Categories ENV1, ENV2, and ENV3 as defined in LR Test Specification No. 1 (2015) & LR Test Specification No. 2 (2015)

## Driver Specifications

See specification 03376 for more information on the Woodward Digital Valve Positioner (DVP)



PO Box 1519, Fort Collins CO, USA 80522-1519  
1041 Woodward Way, Fort Collins CO 80524  
Tel.: +1 (970) 482-5811  
[www.woodward.com](http://www.woodward.com)

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