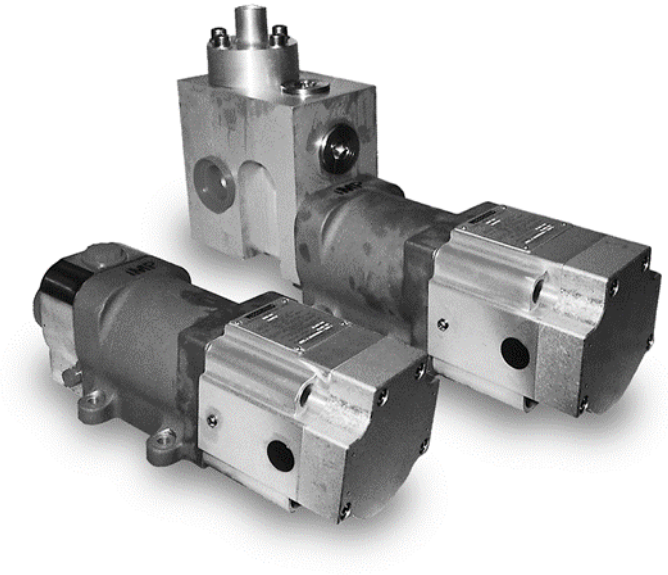
WOODWARD

Product Manual 26476
(Revision E, 4/2025)
Original Instructions



LQ25T and LQ Bypass Valve Actuator Assemblies with Dual Resolver and ID Module

Installation and Operation Manual

Released

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. The latest version of most publications is available on the Woodward website.

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If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. The latest version of most publications is available on the Woodward website.

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Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

If your publication is not on the Woodward website, please contact your customer service representative to get the latest copy.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Contents

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Important Definitions

This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** - Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** - Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** - Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- **NOTICE** - Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** - Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible since they do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

Regulatory Compliance

European Compliance for CE Marking:
These listings are limited only to those units bearing the CE Marking.

EMC Directive Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC).

ATEX Directive: Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Zone 2: II 3 G, Ex nA IIC T3 Gc

Pressure Equipment Directive Directive 2014/68/EU on the harmonisation of the laws of the Member States relating to making pressure equipment available on the market.
PED Category II
PED Module H – Full Quality Assurance,

Other European Compliance:

ATEX Directive: Exempt from the non-electrical portion of the ATEX Directive 2014/34/EU due to no potential ignition sources per EN ISO 80079-36:2016 for Category 2.

RoHS Directive: Restriction of Hazardous Substances 2011/65/EU:
Woodward Turbomachinery Systems products are intended exclusively for sale and use only as a part of Large-Scale Fixed Installations per the meaning of Art.2.4(e) of directive 2011/65/EU. This fulfills the requirements stated in Art.2.4(c) and as such the product is excluded from the scope of RoHS2.

Machinery Directive: Compliant as partly completed machinery with Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.

Other International Compliance

IECEx: Certified for use in explosive atmospheres per Certificate
IECEx CSA 14.0056X Ex nA IIC T3 Gc, IP64

North American Compliance:
These listings are limited only to those units bearing the agency identification.

CSA: CSA Certified for Class I, Div. 2, Groups A, B, C & D, T3C at 103C Ambient For use in Canada and the United States
Certificate 1136436.

Note: LQ25T models with 1 inch SAE ports are not CSA marked or certified.

Special Conditions for Safe Use

Wiring must be in accordance with North American Class I, Division 1 or 2 or European Zone 1, Category 2 or Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Use supply wire suitable for at least 90°C and 10°C above the maximum fluid and ambient temperature. The mating connectors must correctly installed to maintain the IP64 rating. Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut nuire à la conformité de Classe I, Division 2 ou Zone 2 applications

Chapter 1.
General Information

Introduction

The LQ25T or LQ Bypass Valve/Actuator Assemblies with the LQ Digital Driver or DVP Driver integrated liquid fuel metering systems feature valve position control, all-electric actuation, fuel bypass, fuel flow regulation, and fault indication. These systems may allow multiple independent metered flow paths with a single pump.

The LQ Valve assemblies are brushless dc limited angle torquers, which position a metering port for liquid fuel control. The LQ actuators are directly coupled to both the metering port and position feedback resolvers. There are no intervening gears, linkages, or flex couplings. The high torque actuator and shearing action of the shoe on the rotor valve provide a high degree of contamination resistance.

⚠WARNING

The controlling device, not the driver(s) or valve(s), sets turbine stability and response. Follow the instructions for the controlling device while setting up the turbine control system. Failure to follow instructions can cause personal injury and/or property damage.

Turbine manufacturer's requirements for fuel flow to the turbine can vary considerably depending on fuel pressures, fuel types, fuel and ambient temperatures, turbine size, etc. Contact Woodward for information on predicting fuel flow through the LQ Valves as a function of command input signal from the driver. This fuel flow information may be critical to the proper operation of your gas turbine and may be required information for the electronic control system to accelerate and/or decelerate the turbine properly.

IMPORTANT

For complete information on drivers, see manual 26329 for the DVP driver.

Valve Identity Module (ID Module)

The LQ valves have the Identity Module physically positioned within the valve assembly. The purpose of the ID Module is to store and provide the DVP with driver parameter information that is specific to the valve, including but not limited to valve type, resolver position calibration, and flow characterization information. This information is transferred to the DVP upon initial start-up or when explicitly invoking an auto detection procedure.

The customer can view these parameters using the Service Tool Interface. The Service Tool Interface Manual describes detailed usage of the Service Tool Interface.

Drivers

There are two drivers available that will work with the LQ25T and LQ Bypass.

LQ Digital Driver

The LQ Digital Driver is a legacy driver that will work with the new generation LQ25 valves but does not take advantage if the ID Module. For information on this driver, refer to manual 26159.

DVP Driver

The fuel valve is electrically actuated by the Digital Valve Positioner (DVP) off-board driver. The valve/DVP system is designed to accept a demand signal, and then accurately position the fuel metering element. Position feedback is achieved using two resolvers. The resolvers are directly coupled to the fuel-metering element, thus eliminating the need for couplings or gear trains and their associated inaccuracies. The use of a second resolver provides redundancy in terms of position feedback.

Positioner Control Architecture

The DVP / valve system will take a position demand signal and provide the corresponding position of the valve. This positioner controller supports an external flow control algorithm that provides an input to the DVP as either an analog or a digital demand signal. Refer to DVP manual 26329 for more detailed information.

DVP/Valve Operating Modes

The valve can be in four operational modes.

- Running
- Shutdown
- Shutdown Position
- Shutdown System

See DVP manual 26329 for configuration options.

Running:
In this mode the valve is operating normally and is in position control.

Shutdown:
In this mode the valve is still in position control, but there has been a situation that forced the valve into shutdown. The position will be set to zero %. There are different situations that will force the valve into shutdown. See troubleshooting for more details.

Shutdown Position:
If the valve is into the shutdown position mode, the valve will not control position any more. The driver will try to close the valve in current control mode.

Shutdown System:
If the valve is into shutdown system mode, the driver will try to close the valve with a PWM signal. This is the last attempt to close the valve. See troubleshooting for more details on the different situations that will put the valve into the different modes.

Position Control:
In position control, a setpoint is defined based on demand from external sources.

Valve Specific Parameters for Available with the DVP

The following is a description of the valve-specific parameters accessible with the Service Tool interface. See DVP manual 26329 for specific information and complete guide.

Table 1-1. Valve Specific Parameters

User Configurable Parameter Area	Service Tool Page Location	Service Tool Section	Parameter Name
Relubrication Function	Setpoint Source Selection	Relubrication Function Settings	Mode
			Position Step
			Impulse Half Duration
			Delay Time
Shaft Resolver Redundancy Manager	LAT Control Operating Summary	Position Feedback Redundancy Manager	Use Resolver
			Max Resolver Difference Alarm
			Max Resolver Diff Shutdown
Input Filter Settings	LAT Actuator /Valve Configuration	Input Filter Settings	Filter Mode
			Bandwidth (corner frequency)
			Damping Factor
			Noise Suppression Threshold
			Noise Supp. Gain (Below Threshold)

The valve is connected to the DVP, which is connected to the engine control system. Reference DVP manual 26329 for Installation details.

System Accuracy

Total positioning accuracy depends on the calibrated stroke and driver option as follows:

LQ Digital Driver

The positioning accuracy of the digital driver using the RS-485 (digital) demand input is 0.1 degree including temperature drift. The positioning accuracy of the digital driver using the analog (4–20 mA) demand input is 0.1 + (0.0179 x *span**). The rotary valve travel for the LQ25T and LQ Bypass is 66 degrees, giving a positional accuracy of 1.281 degrees.

*—span = range of travel in angular degrees

DVP Driver

The positioning accuracy of the digital driver using one of the digital demand inputs is 0.1 degree including temp drift. The positioning accuracy of the digital driver using the analog (4–20 mA) demand input is reduced by the DVP analog accuracy provided in manual 26239.

System Position Bandwidth and Damping

System bandwidth is 40 rad/s (6.4 Hz). The frequency response mimics a two-pole linear system, with the bandwidth corresponding to –6 dB gain. The damping factor is set to 1. Equivalent dead time does not exceed 20 ms, which includes all effects, such as communications, processing time, mechanical times, etc.

LQ25T Fuel Metering Valve

The LQ25T Liquid Fuel Valve has all-electric actuation. The actuation, metering, and feedback are integrated on the motor rotor. Either one single-speed resolver, one three-speed resolver, or dual three-speed resolvers give feedback. Regulation is achieved through an integral, single stage, throttling differential pressure regulator.

The valve is intended for use on industrial gas turbines in the 6000 to 42 000 kW power range. Specifically, this design will operate in conjunction with any type of “pressure source” fuel system (centrifugal type pump or bypassing system on a positive displacement pump that controls inlet pressure to this valve). Flow metering is implemented with the use of an electrically actuated rotary plate and shoe-type valve with electrical dual-position feedback. There are three port sizes for the LQ25T:

- 65 mm² (0.1 in²) port is designed for maximum fuel flows of 1814 to 3402 kg/h (4000 to 7500 lb/h)
- 129 mm² (0.2 in²) port is designed for maximum fuel flows of 3742 to 6804 kg/h (8250 to 15 000 lb/h)
- 194 mm² (0.3 in²) port is designed for maximum fuel flows of 8165 to 9979 kg/h (18 000 to 22 000 lb/h).

The minimum-metered flow of the LQ25T is 45 kg/h (100 lb/h). These flows assume a specific gravity of 0.77. All materials of the LQ25T are corrosion resistant or protected against corrosion.

The valve is designed to automatically purge trapped air or fuel vapor within the internal passages. No provision for manual bleeding of the valves in required. The valve is self-cleaning, with a shear action metering section.

In addition to the base metering valve, the LQ25T has a dual-resolver option. The dual-resolver option provides redundant feedback devices in order to have a backup if a resolver fails.

The LQ25T will be commanded to a minimum flow position in the event of a detected failure within the valve or driver assemblies. Loss of electrical power results in the valve moving towards the minimum flow or full closed position or holding at the last commanded position.

Operation of the LQ25T Valve

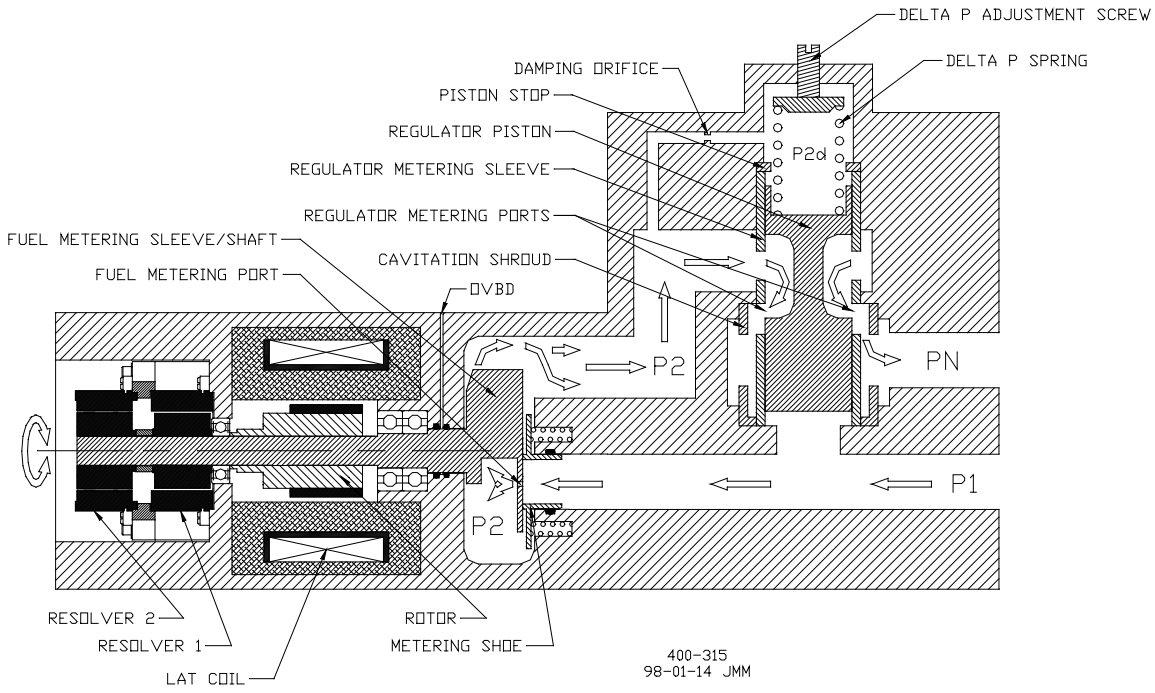


Figure 1-1. LQ25T Valve Schematic

The LQ25T Liquid Fuel Metering Valve meters fuel as a function of the angular position of its ported metering sleeve/shaft. The metering sleeve/shaft is positioned by the integrated, brushless, dc, limited angle torquer motor (LAT). A resolver or dual resolvers, mounted directly on the shaft of the valve, provide valve position feedback.

To accurately meter fuel, the valve maintains a constant pressure drop across the fuel metering port in the metering sleeve/shaft. The valve regulates the intermediate pressure to (P2) to maintain this constant pressure differential by positioning the throttling regulator piston.

Given the constant pressure differential within the fuel valve, the fuel flow through the metering port is always proportional to the area of the port opening. Fuel flow through the metering port of the valve is described by the following equation:

$$MassFuelFlow = k \times Area \times \sqrt{\Delta P \times SG}$$

Under operating conditions, fuel at the system pressure (P1) flows to the metering sleeve/shaft and to one side of the regulator piston. Metered fuel at the intermediate pressure (P2) is directed to the regulator metering ports and through a damping orifice (P2d) to the other side of the regulator piston. The regulator metering ports' effective area is such that the metered flow is throttled from the intermediate pressure (P2) to the outlet pressure (PN).

⚠WARNING **The fuel system MUST have a separate liquid fuel positive shutoff valve. Failure to provide a separate shutoff valve may result in a possibly dangerous overspeed situation.**

The piston takes a position at which the force from pressure P1 acting on the piston's effective area is equal to the sum of the forces from the pressure P2d acting on the piston's effective area and the force from the delta P spring. When the balance of forces has been established, the difference between the spring force acting on the piston is equal to the difference between the pressures (P1–P2d) acting on equal effective areas, and the pressure drop across the regulator metering ports is the difference between P2 and PN.

By varying the force of the ΔP spring, the pressure difference (typically 345 kPa/3.45 bar/50 psid) can be adjusted to suit the requirements of a particular application.

As long as the inlet pressure (P1) is sufficiently high (typically greater than 827 kPa/8.27 bar/120 psid), the intermediate pressure (P2) is maintained and the metered flow is unaffected by the valve downstream pressure (PN).

LQ Bypass Valve

The LQ Bypass Valve is an electrically-actuated fuel flow-throttling valve. This modulating, two-way valve assembly is used to control the discharge pressure of a positive displacement fuel pump by bypassing flow to a low-pressure volume. It is used in conjunction with an electronic pressure control system and fuel pressure transducers (not included) to enable pump pressure to be accurately scheduled as a function of other system parameters. The actuation, metering, and feedback are integrated on the motor rotor. Flow direction is reversed through the LQ Bypass Valve to reduce cavitation erosion damage within the valve.

The valve is intended for use on industrial gas turbines in the 1000 to 42 000 kW power range. Flow metering is implemented with the use of an electrically actuated rotary plate and shoe-type valve with electrical dual position feedback.

The valve is designed to automatically purge trapped air or fuel vapor within the internal passages. No provision for manual bleeding of the valves is required. The valve is self-cleaning, with a shear action metering section.

In the event of a detected valve or DVP fault that results in a DVP shutdown, the Bypass Valve will be driven to the fully closed, minimum flow position. This action may result in increasing fuel system pressure. The fuel system design should incorporate a pressure relief device to accommodate this shutdown condition.

In the event of a loss of electrical power to the valve or DVP, the Bypass Valve will remain near the last commanded position or move towards an increasing flow position.

Operation of the LQ Bypass Valve

Flow direction is reversed in the LQ Bypass valve as compared to the LQ25T, and there is no ΔP section as metering accuracy is not as critical. A cavitation shield is included to reduce cavitation erosion damage within the valve.

WARNING

The fuel system MUST have a separate liquid fuel positive shutoff valve. Failure to provide a separate shutoff valve may result in a possibly dangerous overspeed situation.

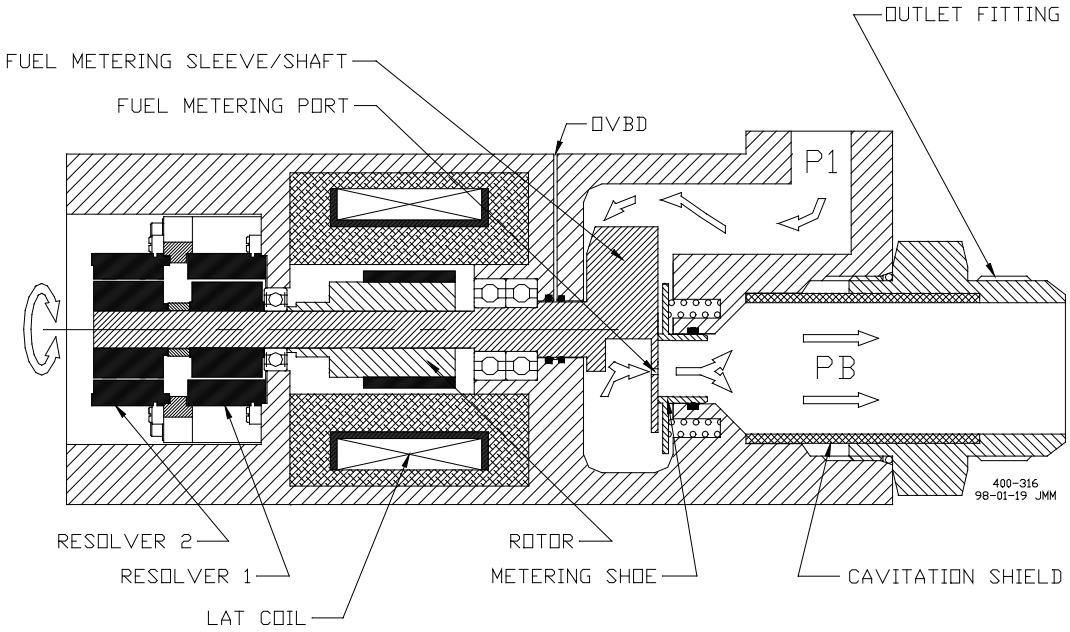


Figure 1-2. LQ Bypass Valve Schematic

Chapter 2
Installation

LQ Valve Unpacking

Use care when unpacking the LQ Valve. Abuse can damage seals, installation surfaces, and factory adjustments. Notify the shipper and Woodward if damage is found.

⚠WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

⚠CAUTION

Due to typical noise levels in turbine or engine environments, hearing protection should be worn when working on or around the LQ25T or LQ Bypass valves.

⚠CAUTION

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

⚠CAUTION

Do not lift or handle the valve by any conduit or connector. The use of a strap suitable for lifting 22 kg (49 lb) is recommended for handling the LQ25T and LQ Bypass valves.

NOTICE

Take care not to damage the cover seal, the cover surface, or the actuator surface while removing or replacing the cover.

IMPORTANT

For Zone 1 / Division 1 products: Proper torque is very important to ensure that the unit is sealed properly.

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the conduit and joint surfaces to ensure that they are not damaged or contaminated.

For Zone 1 valves: The LQ25T and LQ Bypass valves are certified to a Zone 1, Category 2 method of protection. Wiring methods must comply with the Zone 1, Category 2 method of protection when installed in a Zone 1 classified atmosphere.

⚠WARNING

Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagrams (Figures 2-4 & 2-5).

LQ25T Valve Mounting

The valve should be mounted as close to the turbine as practical in order to minimize the volume of fuel between the valve and the turbine. Ensure that the valve is not mounted in an area that would exceed the temperature limits specified in Chapter 3: Detailed Specifications. The LQ25T valve should be mounted to a thermally conductive surface to conduct heat away from the actuator and maintain proper coil temperature.

See Figure 2-1 for dimensions of the LQ25T mounting hole pattern. The valve should be securely attached to a clean, flat, rigid surface that will not exceed the vibration limits specified in Chapter 3: Detailed Specifications.

Connect inlet, outlet, and overboard lines to the valve. The inlet port receives pressurized fuel from the pump. The outlet line should be attached to the fuel line(s) going to the turbine combustors. The bypass line must be connected back to the fuel storage tank. The overboard (OVBD) drain port depicted in Figure 2-2 is a vent between dual redundant shaft seals. It must be connected by means of rigid steel piping to a fuel collection, purge, vent, or flare off system so as not to be exposed to danger of obstruction, physical damage, or back pressure in excess of 69 kPa (0.69 bar/10 psig).

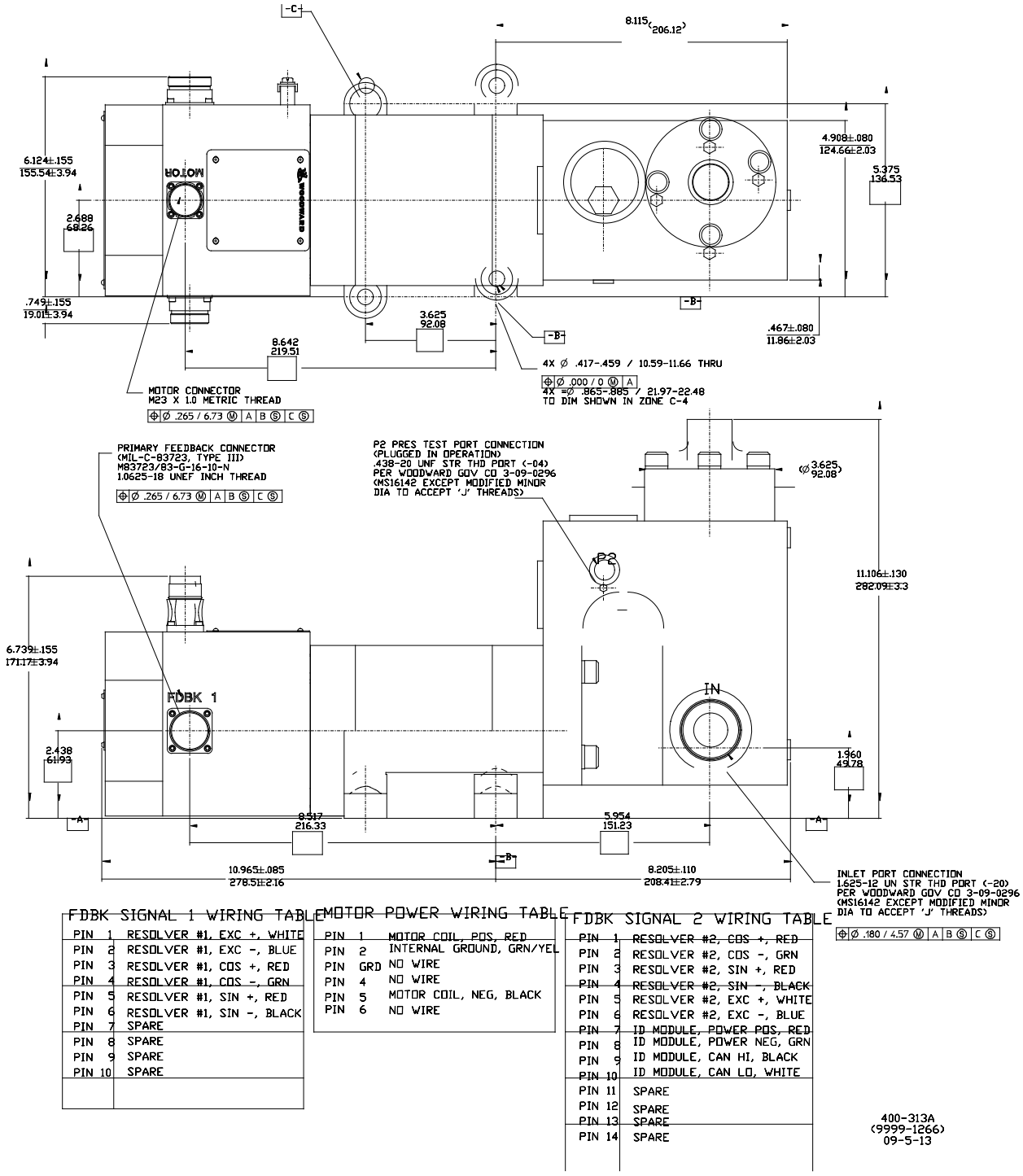
IMPORTANT

Leakage exceeding 20 cm^3/min from the overboard drain line indicates a worn or damaged shaft seal in the LQ valve and should be investigated immediately. Special tooling is required to replace the shaft seal. Contact Woodward for service.

LQ Bypass Valve Mounting

The valve should be mounted as close to the pump between the valve and the engine's fuel metering valves as is practical. The bypassing outlet of the valve should be connected to 51 mm (2 inch) diameter steel or stainless steel pipe with a minimum straight length of 1.2 m (4 feet). Ensure that the valve is not mounted in an area that would exceed the temperature limits specified in Chapter 3: Detailed Specifications. The LQ Bypass valve must be mounted to a thermally conductive surface to conduct heat away from the actuator and maintain proper coil temperature.

See Figure 2-2 for dimensions of the LQ Bypass mounting hole pattern. The valve should be securely attached to a clean, flat, rigid surface that will not exceed the vibration limits specified in Chapter 3: Detailed Specifications.



FDBK SIGNAL 1 WIRING TABLE

PIN 1	RESOLVER #1, EXC +, WHITE
PIN 2	RESOLVER #1, EXC -, BLUE
PIN 3	RESOLVER #1, COS +, RED
PIN 4	RESOLVER #1, COS -, GRN
PIN 5	RESOLVER #1, SIN +, RED
PIN 6	RESOLVER #1, SIN -, BLACK
PIN 7	SPARE
PIN 8	SPARE
PIN 9	SPARE
PIN 10	SPARE

MOTOR POWER WIRING TABLE

PIN 1	MOTOR COIL, POS, RED
PIN 2	INTERNAL GROUND, GRN/YEL
PIN GRD	NO WIRE
PIN 4	NO WIRE
PIN 5	MOTOR COIL, NEG, BLACK
PIN 6	NO WIRE

FDBK SIGNAL 2 WIRING TABLE

PIN 1	RESOLVER #2, COS +, RED
PIN 2	RESOLVER #2, COS -, GRN
PIN 3	RESOLVER #2, SIN +, RED
PIN 4	RESOLVER #2, SIN -, BLACK
PIN 5	RESOLVER #2, EXC +, WHITE
PIN 6	RESOLVER #2, EXC -, BLUE
PIN 7	ID MODULE, POWER POS, RED
PIN 8	ID MODULE, POWER NEG, GRN
PIN 9	ID MODULE, CAN HI, BLACK
PIN 10	ID MODULE, CAN LO, WHITE
PIN 11	SPARE
PIN 12	SPARE
PIN 13	SPARE
PIN 14	SPARE

Figure 2-1a. 1 1/4–Inch LQ25T Outline Drawing

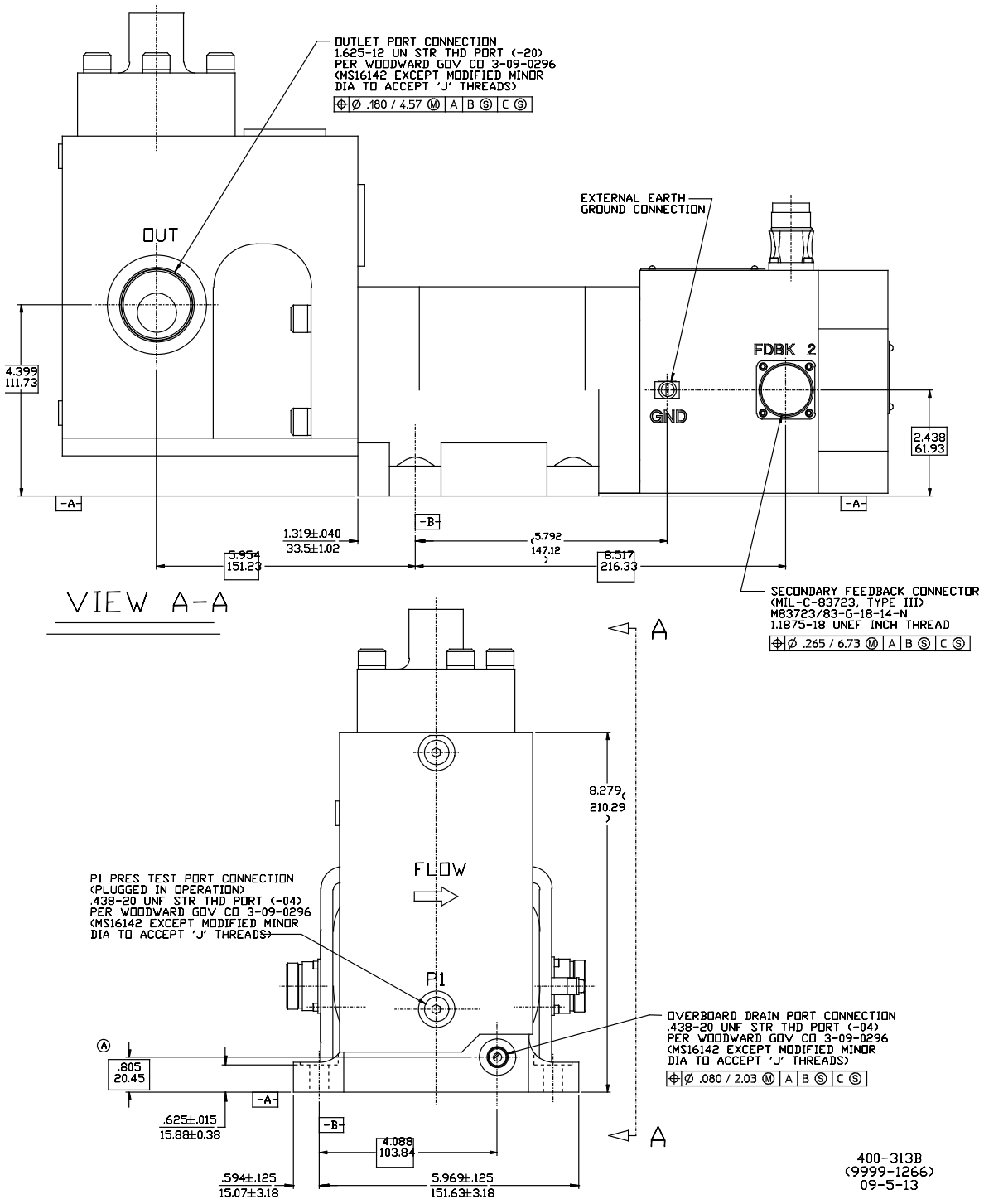
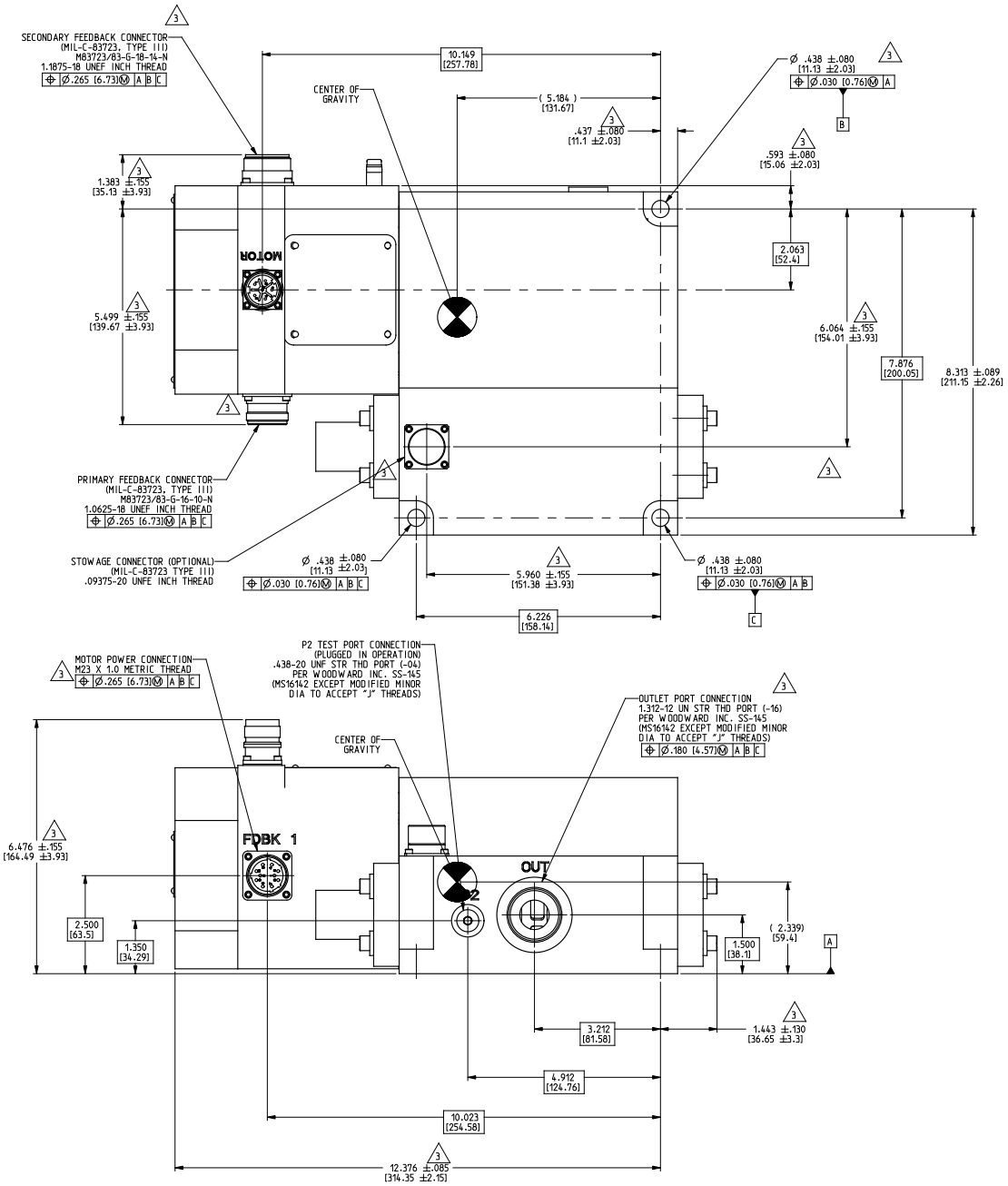


Figure 2-1b. 1 1/4-Inch LQ25T Outline Drawing

⚠WARNING

Do not plug the overboard drain as this may cause fuel to enter the LQ25T actuator, resulting in a hazardous condition with the potential to cause personal injury and/or damage to the actuator.

The overboard drain piping must be sufficiently sloped to eliminate the possibility of stagnant water which could freeze and plug the drain, resulting in a hazardous condition with the potential to cause personal injury and/or damage to the valve.



FDBK SIGNAL 1 WIRING TABLE	
PIN 1	RESOLVER #1, EXC +, WHITE
PIN 2	RESOLVER #1, EXC -, BLUE
PIN 3	RESOLVER #1, COS +, RED
PIN 4	RESOLVER #1, COS -, GRN
PIN 5	RESOLVER #1, SIN +, RED
PIN 6	RESOLVER #1, SIN - , BLACK
PIN 7	SPARE
PIN 8	SPARE
PIN 9	SPARE
PIN 10	SPARE

MOTOR POWER WIRING TABLE	
PIN 1	MOTOR COIL, POS, RED
PIN 2	INTERNAL GROUND, GRN/YEL
PIN GND	NO WIRE
PIN 4	NO WIRE
PIN 5	MOTOR COIL, NEG, BLACK
PIN 6	NO WIRE

FDBK SIGNAL 1 WIRING TABLE	
PIN 1	RESOLVER #2, COS +, RED
PIN 2	RESOLVER #2, COS -, GRN
PIN 3	RESOLVER #2, SIN +, RED
PIN 4	RESOLVER #2, SIN -, BLACK
PIN 5	RESOLVER #2, EXC +, WHITE
PIN 6	RESOLVER #2, EXC - , BLUE
PIN 7	ID MODULE, POWER POS, RED
PIN 8	ID MODULE, POWER NEG, GRN
PIN 9	ID MODULE, CAN HI, BLACK
PIN 10	ID MODULE, CAN LO, WHITE
PIN 11	SPARE
PIN 12	SPARE
PIN 13	SPARE
PIN 14	SPARE

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Figure 2-1c. 1-Inch LQ25T Outline Drawing

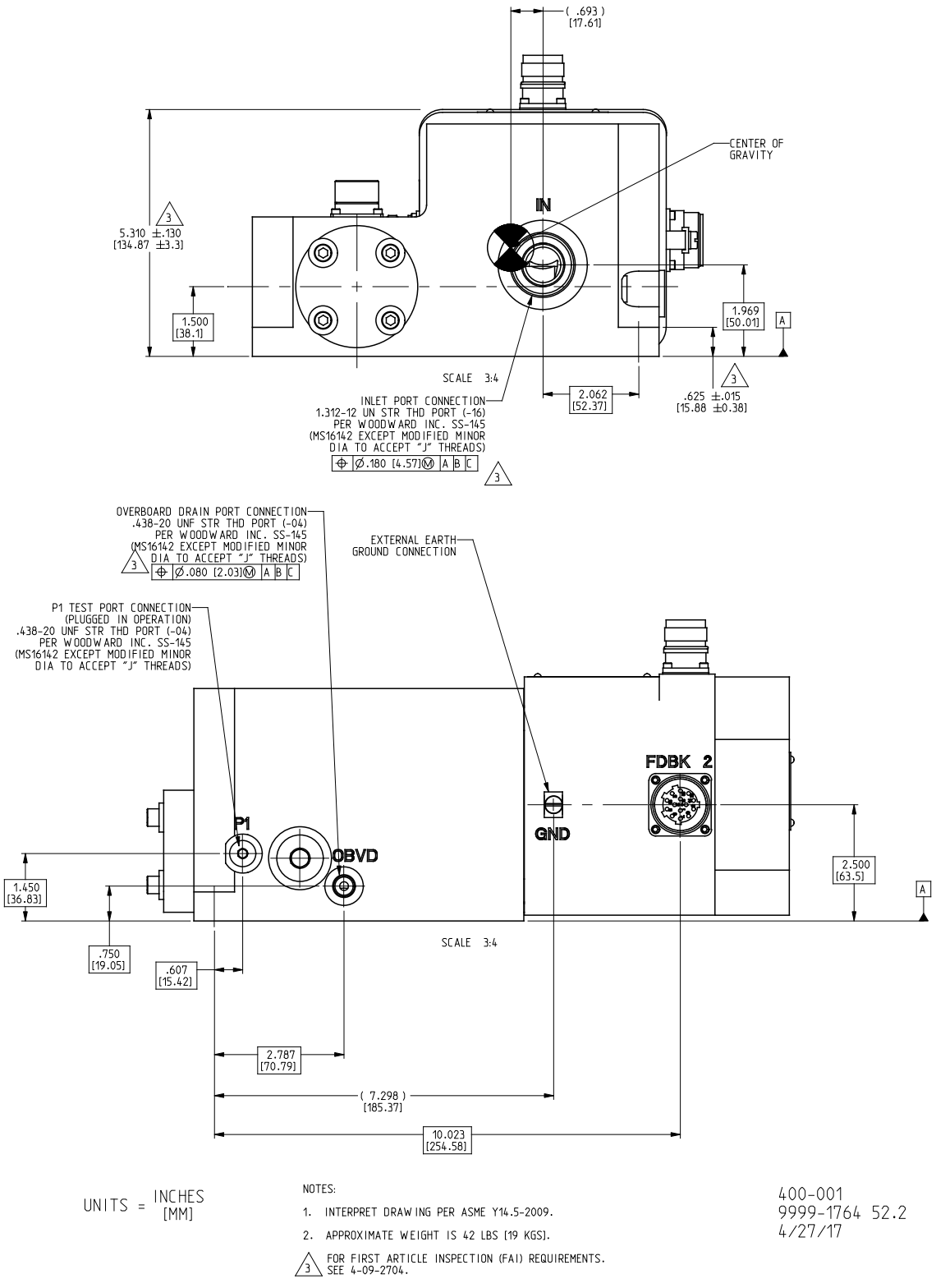
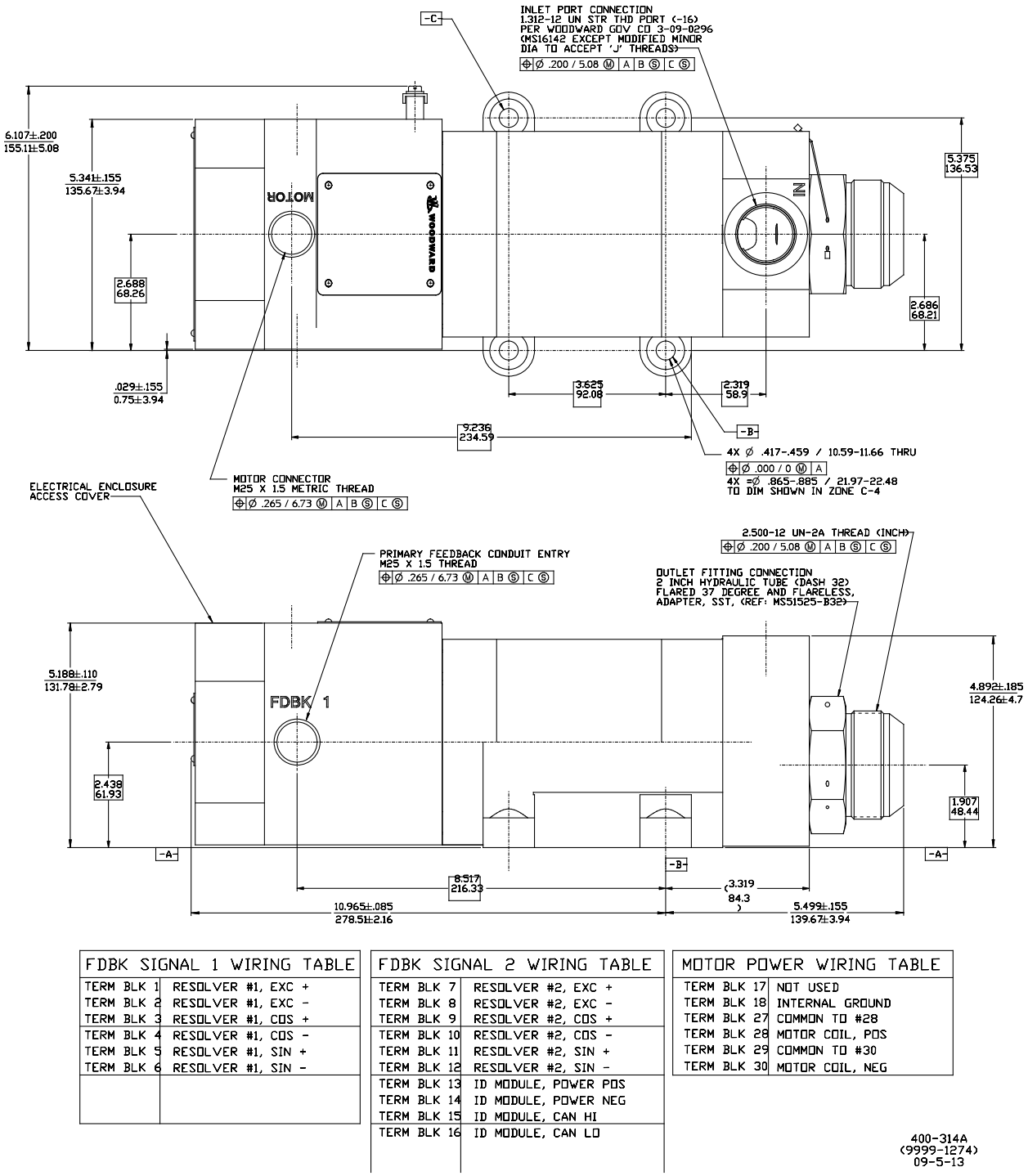


Figure 2-1d. 1-Inch LQ25T Outline Drawing

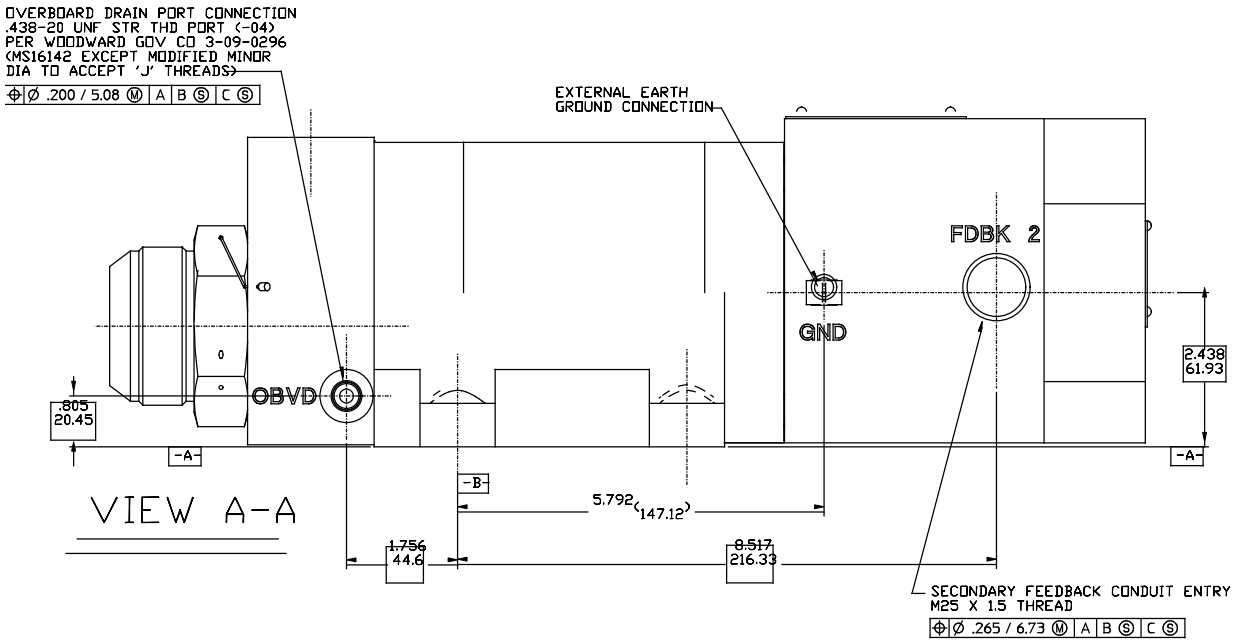


FDBK SIGNAL 1 WIRING TABLE	
TERM BLK 1	RESOLVER #1, EXC +
TERM BLK 2	RESOLVER #1, EXC -
TERM BLK 3	RESOLVER #1, COS +
TERM BLK 4	RESOLVER #1, COS -
TERM BLK 5	RESOLVER #1, SIN +
TERM BLK 6	RESOLVER #1, SIN -

FDBK SIGNAL 2 WIRING TABLE	
TERM BLK 7	RESOLVER #2, EXC +
TERM BLK 8	RESOLVER #2, EXC -
TERM BLK 9	RESOLVER #2, COS +
TERM BLK 10	RESOLVER #2, COS -
TERM BLK 11	RESOLVER #2, SIN +
TERM BLK 12	RESOLVER #2, SIN -
TERM BLK 13	ID MODULE, POWER POS
TERM BLK 14	ID MODULE, POWER NEG
TERM BLK 15	ID MODULE, CAN HI
TERM BLK 16	ID MODULE, CAN LO

MOTOR POWER WIRING TABLE	
TERM BLK 17	NOT USED
TERM BLK 18	INTERNAL GROUND
TERM BLK 27	COMMON TO #28
TERM BLK 28	MOTOR COIL, POS
TERM BLK 29	COMMON TO #30
TERM BLK 30	MOTOR COIL, NEG

Figure 2-2a. LQ Bypass Outline Drawing



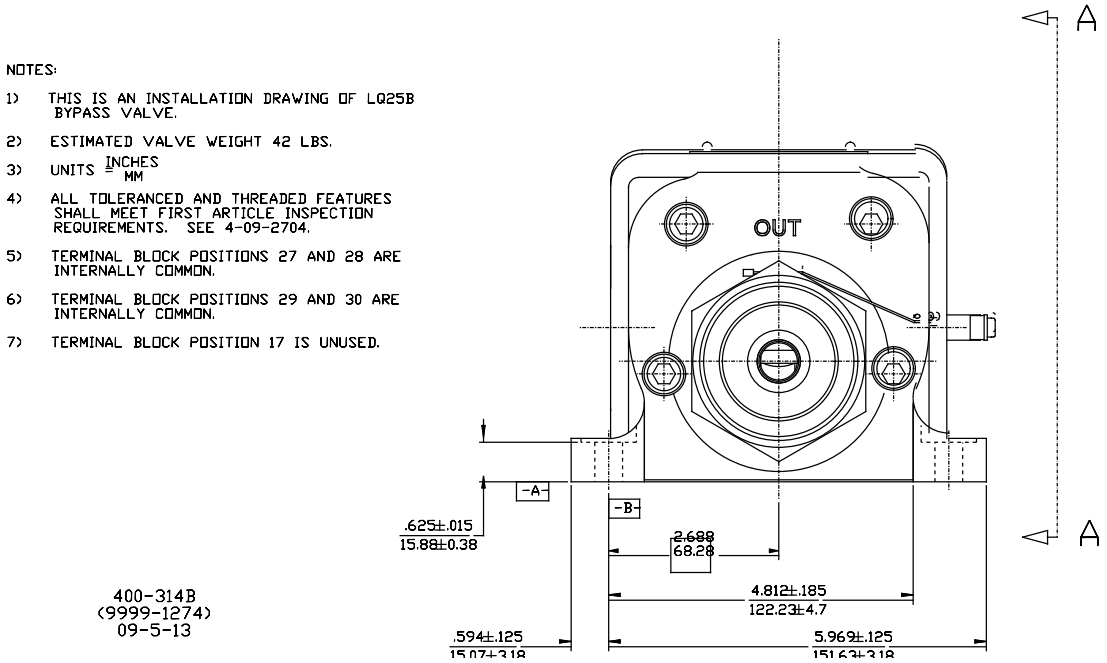


Figure 2-2b. LQ Bypass Outline Drawing

⚠WARNING

Do not plug the overboard drain as this may cause fuel to enter the LQ Bypass actuator, resulting in a hazardous condition with the potential to cause personal injury and/or damage to the actuator.

The overboard drain piping must be sufficiently sloped to eliminate the possibility of stagnant water which could freeze and plug the drain, resulting in a hazardous condition with the potential to cause personal injury and/or damage to the valve.

⚠WARNING

The fuel exiting the LQ Bypass Valve will be at high velocity and may cause cavitation erosion in the downstream piping, resulting in a major fuel leak and the associated environmental and fire/explosion hazards. The 690 to 1380 kPa (6.9 to 13.8 bar/100 to 200 psig) back pressure and outlet fitting are specifically designed to minimize this cavitation erosion potential. The 1.2 m (4 foot) straight length of 51 mm (2 inch) diameter steel or stainless steel pipe is required to minimize this erosion, but the pipe must be regularly inspected to ensure its integrity.

IMPORTANT

The 49 000 cm³ (49 L/3000 in³) volume between the LQ Bypass Valve and the engine's fuel metering valves is required to ensure accurate system pressure control and subsequent fuel control.

Leakage exceeding 20 cm³/min from the overboard drain line indicates a worn or damaged shaft seal in the LQ Bypass valve and should be investigated immediately. Special tooling is required to replace the shaft seal. Contact Woodward for service.

IMPORTANT

For Zone 1 / Division 1 products: Proper torque is very important to ensure that the unit is sealed properly.

LQ Wiring

Cable Connections

Wiring for the driver power output to the actuator must be suitable for at least 90 °C, and 10 °C above maximum fluid and ambient temperature.

Resolver wiring is non-incendive and may be installed in accordance with wiring methods suitable for ordinary locations.

Table 2-1. Conduit Connections

Actuator	M25 x 1.5
Resolver 1	M25 x 1.5 (three shielded, twisted pairs or one shielded, twisted, six-conductor cable)
Resolver 2 & ID Module	M25 x 1.5 (five shielded, twisted pairs or one shielded, twisted, six-conductor cable and one four-conductor CAN cable)
External Grounding Stud	Suitable for wire size 10 mm² to 4 mm² (8 to 12 AWG)

Wiring

The driver must be mounted close enough to the valve and the driver power supply to meet wire length requirements specified in the driver manual.

Make electrical connections between the valve and driver according to the wiring diagrams (Figure 2-4) for valve connections and per driver manual for driver end (see manual 26159 for the digital driver and manual 26239 for the DVP driver).

Connect ground terminal of actuator to earth ground. This must be the same grounding system as the driver's earth ground.

WARNING **EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.**

The valve has a green lead wire, which must be connected, to earth ground. This may be connected to the terminal provided on the driver (TB1-8). In the event of a fault in the actuator, this terminal may be used to carry fault currents through the chassis of the LQ Driver and out the PE terminal to earth.

Terminal blocks are used on all LQ valves with conduit connections. These terminal blocks are top load, cage clamp style, and are actuated by inserting a DIN 5264 screwdriver into the opening behind the wire slot. Once the cage clamp has been opened, the wire can be inserted, and the screwdriver removed. Please see the illustration and instructions below:

- The screwdriver is inserted into the operating slot up to the stop.
- The screwdriver blade holds the clamping spring open automatically so that the conductor can be introduced into the clamping unit.
- The screwdriver is withdrawn. The conductor is automatically clamped.

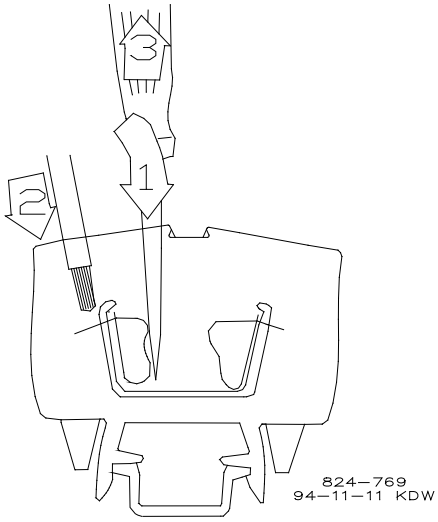


Figure 2-3. WAGO 264 Series Terminal Block

All shielded cable must be twisted conductor pairs with either a foil or a braided shield. All signal lines should be shielded to prevent picking up stray signals from nearby equipment. Connect the shields as shown in the wiring diagram (Figure 2-4). Wire exposed beyond the shield must be as short as possible.

IMPORTANT **Connect cable shields to earth ground on the driver. Do not connect any cable shields to "instrument ground", "control ground", or any non-earth ground system.**

For best noise immunity, run power wires and shielded signal wires in separate conduits or cable trays. See Woodward Manual 50532, *EMI Control in Electronic Governing Systems*, for more information.

Tables 2-4 through 2-6 LQ25T and LQ Bypass Valve Connections with Dual 3-speed Resolver

Table 2-2. Motor Power Wiring Table

TERMINAL BLOCK 17	NOT USED
TERMINAL BLOCK 18	INTERNAL GROUND
TERMINAL BLOCK 27	COMMON TO #28
TERMINAL BLOCK 28	MOTOR COIL POSITIVE
TERMINAL BLOCK 29	COMMON TO #30
TERMINAL BLOCK 30	MOTOR COIL NEGATIVE

Table 2-3. Feedback Signal 1 Wiring Table

TERMINAL BLOCK 1	RESOLVER #1 EXC +
TERMINAL BLOCK 2	RESOLVER #1 EXC -
TERMINAL BLOCK 3	RESOLVER #1 COS +
TERMINAL BLOCK 4	RESOLVER #1 COS -
TERMINAL BLOCK 5	RESOLVER #1 SIN +
TERMINAL BLOCK 6	RESOLVER #1 SIN -

Table 2-4. Feedback Signal 2 Wiring Table

TERMINAL BLOCK 7	RESOLVER #2 EXC +
TERMINAL BLOCK 8	RESOLVER #2 EXC -
TERMINAL BLOCK 9	RESOLVER #2 COS +
TERMINAL BLOCK 10	RESOLVER #2 COS -
TERMINAL BLOCK 11	RESOLVER #2 SIN +
TERMINAL BLOCK 12	RESOLVER #2 SIN -
TERMINAL BLOCK 13	I.D. MODULE POWER POSITIVE
TERMINAL BLOCK 14	I.D. MODULE POWER NEGATIVE
TERMINAL BLOCK 15	I.D. MODULE CAN HI
TERMINAL BLOCK 16	I.D. MODULE CAN LO

Connectors (DVP only)

Make electrical connections between the valve and driver with cables built to the requirements of Figures 2-5a, 2-5b, or 2-5c.

Connect external ground terminal of actuator to earth ground. This must be the same grounding system as the driver's earth ground.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

The valve has a green lead wire, which must be connected, to earth ground. This may be connected to the terminal provided on the driver (TB1-8). In the event of a fault in the actuator, this terminal may be used to carry fault currents through the chassis of the LQ Driver and out the PE terminal to earth.

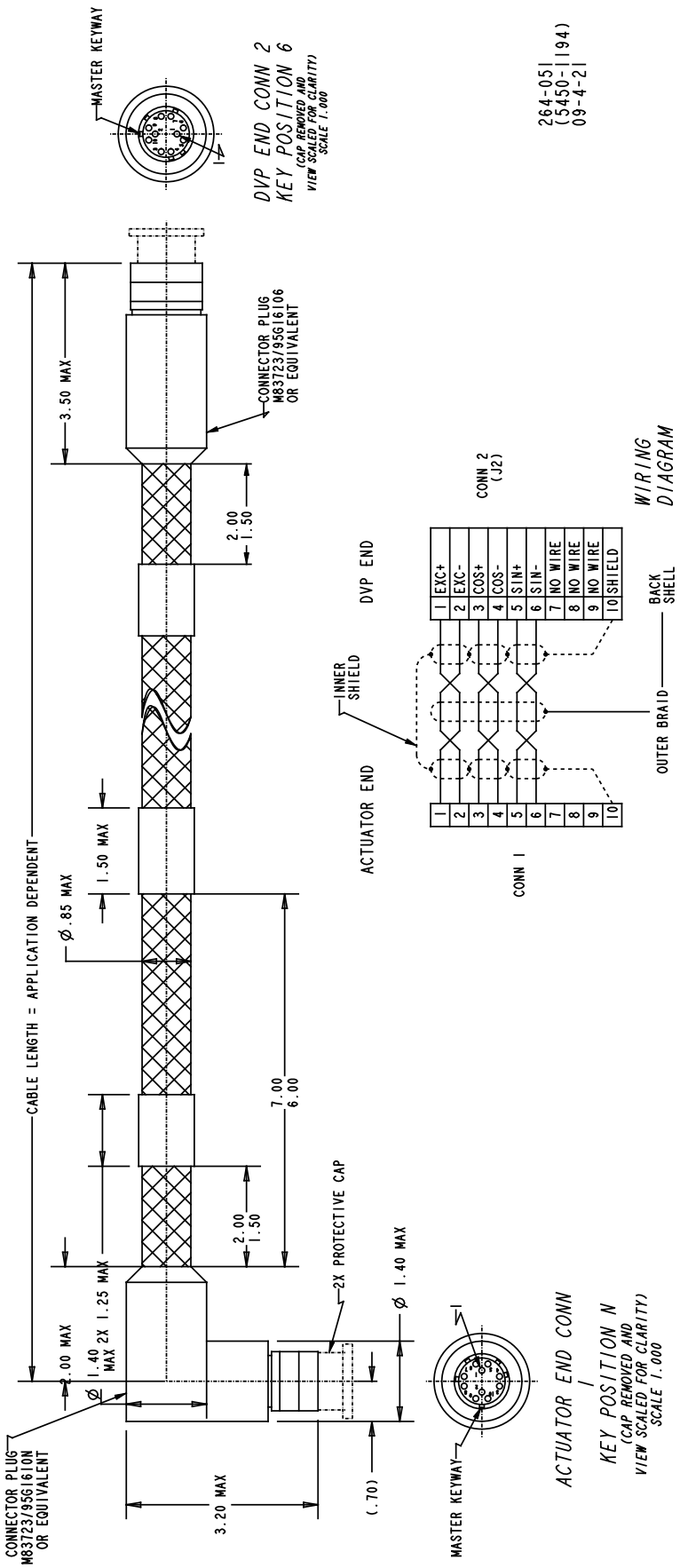


Figure 2-5a. Cable, Feedback 1 Resolver Signal

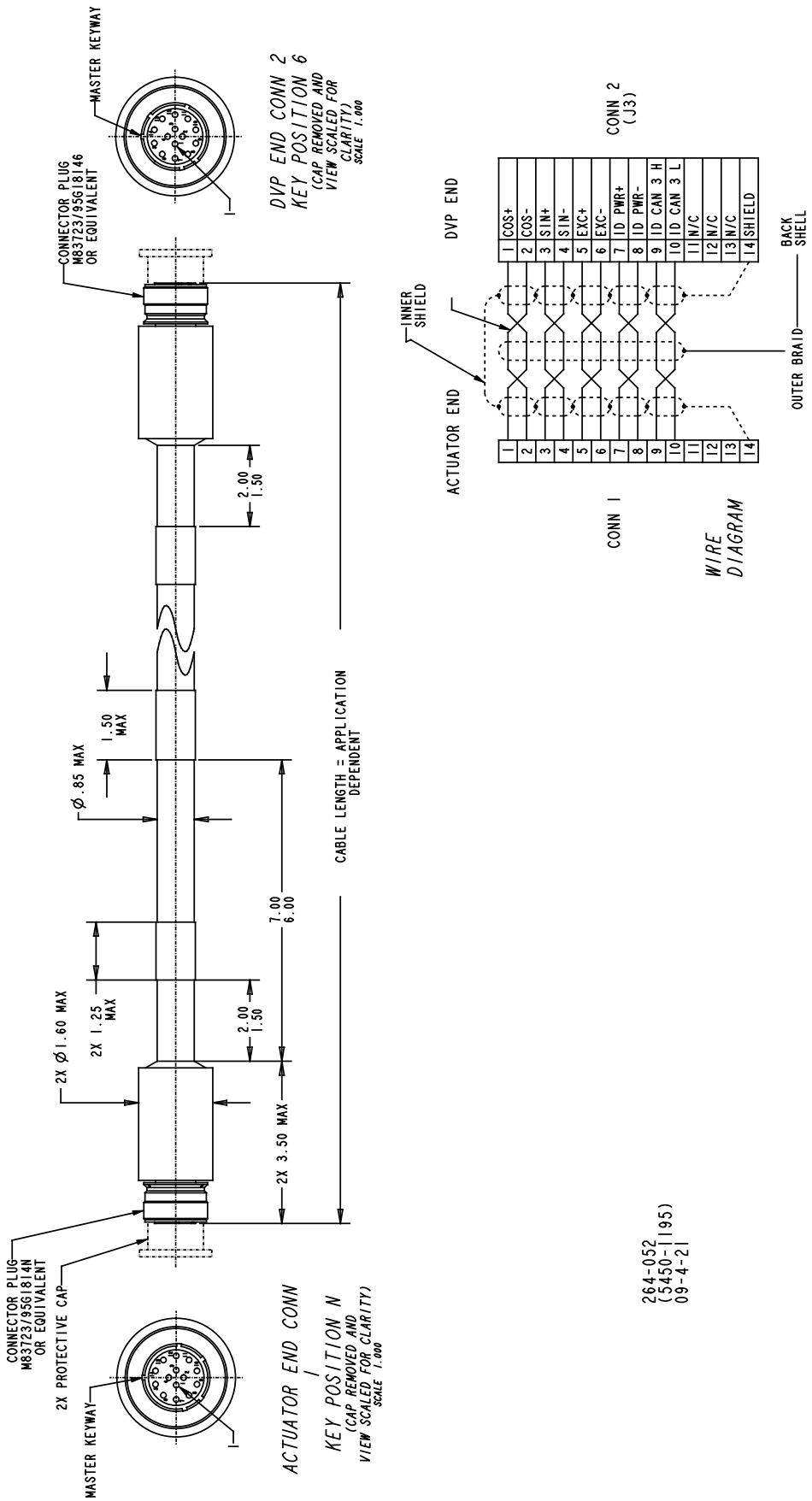


Figure 2-5b. Cable, Feedback 2 Resolver Signal, and ID Module

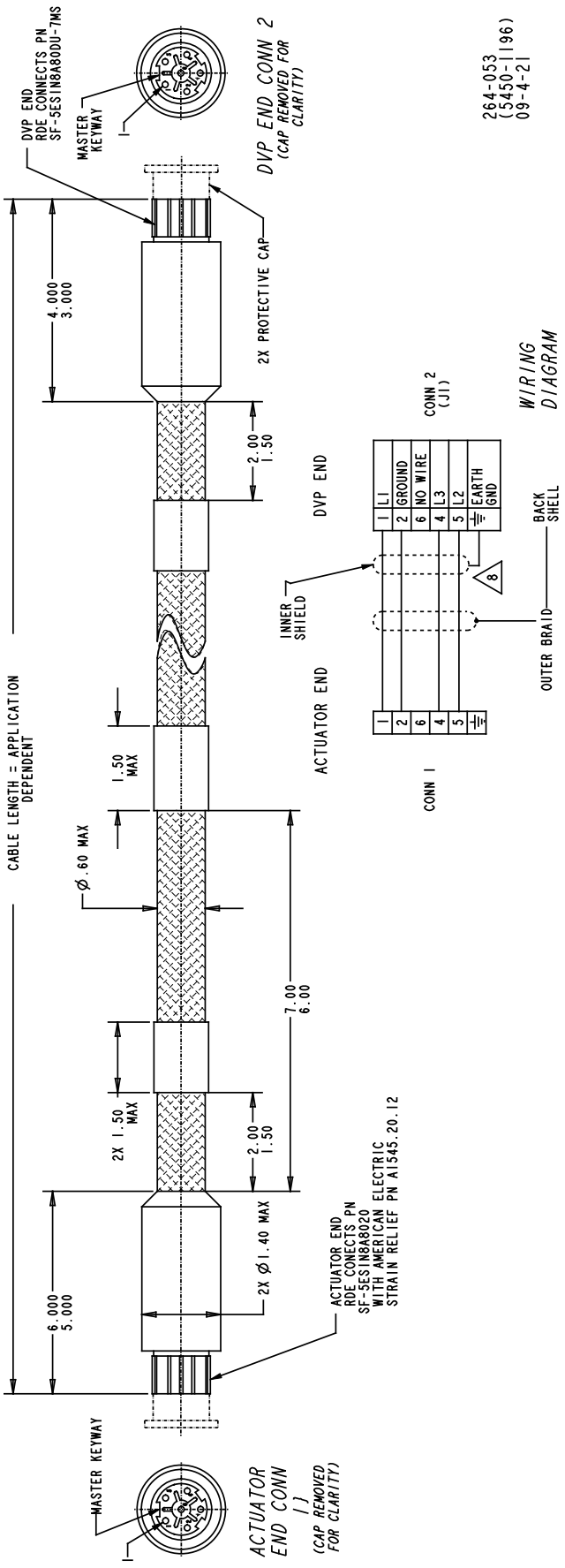


Figure 2-5c. Cable, Motor Power

Chapter 3.
Detailed Specification

1 1/4-Inch LQ25T Valve Specifications

Environmental Specifications

Operating Temperature:	–40 to +103 °C (–40 to +217 °F)
Storage Temperature:	–40 to +103 °C (–40 to +217 °F)
Vibration:	US MIL-STD-810C, Procedure 1, Table 514.2-ii, 20 Hz to 1000 Hz Figure 514.2-2, Curve J (5g)
Shock:	US MIL-STD-810C, Method 516.2, Procedure 1, 20 g, 11 ms, sawtooth wave form
Valve Weight:	22 kg (49 lb)
Airborne Noise:	Wear ear protection while valve is operating
Electromagnetic Interference:	EN61000-6-4, 2007: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments, and EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
Ingress Protection (IEC 60529, IEC 60079-0)	IP64

Electrical Characteristics

Dielectric Withstand:	1064 Vac from motor phases to Protective Earth (PE) ground; 500 Vac from all I/O to PE ground
Coil	
Coil Resistance:	0.54 ohms ±10% at 20 °C
Coil Inductance:	20 mH at 60 Hz
Insulation Resistance:	> 50 mΩ after dielectric test
DVP Input Voltage:	24Vdc nom. or 125 Vdc nom. (see DVP manual 26329)
Actuator Current:	3 A steady state, 8 A max. Expected transient current may be up to 20A with a maximum of 20% duty cycle
Feedback Device—	
Type:	Frameless resolver (three-speed)
Excitation:	7 Vac at 4000 Hz
Return:	3.5 Vac at 4000 Hz

Steady State Performance Characteristics

Range of Maximum Metered Flows:	1814 to 9979 kg/h (4000 to 22 000 lb/h)
Range of Minimum Metered Flows:	27 to 454 kg/h (60 to 1000 lb/h)
Fuel Supply Pressure Range—Normal Operation:	1034 to 9653 kPa (10.3 to 96.5 bar/150 to 1400 psig)
Max Inlet (Proof Pressure):	19 MPa (193 bar/2800 psig)
Min Burst Pressure:	48 MPa (483 bar/7000 psig)
Max Internal Fuel Leakage:	27 kg/h (60 lb/h)
Nominal Diameter:	41.3 mm (1.625 inches)

Fuel Pressure Differentials

Nominal Regulated Metering Valve ΔP:	345 kPa (3.45 bar/50 psid)
ΔPressure Droop:	±6.9 kPa (±0.069 bar/±1.0 psid) w/ droop compensations in control
Total Differential Pressure:	P1 to PN 827 to 9653 kPa (8.3 to 96.5 bar/120 to 1400 psid) For dynamic response, P1 to PN must be at least 1380 kPa (13.8 bar/200 psid).
Chip Shearing Force Capability:	134 N (30 lb force) minimum at the metering port edge

Flow Metering Accuracy:	Greater of ±5.0% of point or ±0.5% of maximum flow using 4–20 mA input Greater of ±2.5% of point, or 0.1% of maximum flow, or 6.8 kg/h (15 lb/h), using RS-485 and droop compensation in control (including all effects—valve position, ΔP, temperature)
Valve Positioning Stability:	Oscillations < ±0.05% of full stroke
Metered Flow Dynamic Response:	> 25 rad/s bandwidth (for ±2% of stroke)
Max Slew Time:	0.100 s (measured from 10 to 90% or 90 to 10%)

Liquid Fuel Types And Test Fluids

Operating Fuel Types:	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.
Fluid Inlet Temperature Range:	–40 to +103 °C (–40 to +217 °F)
Gravity Range:	0.650 to 0.900
Fuel Viscosity Range:	0.50 to 12.0 Centistokes
Inlet Fuel Filtration Levels:	Filter liquid fuel 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.

Operating Life

Mean Time Between Overhauls:	>50 000 operating hours
Cyclic Life:	>150 000 full stroke cycles
Total Design Life with Overhauls:	>150 000 operating hours
Storage Life:	>10 years, non-operating

Torque Values:

Electrical Cover Screws:	77–85 lb-in (8,7–9.6 N·m)

1-Inch LQ25T Valve Specifications

Environmental Specifications

Operating Temperature:	–40 to +103 °C (–40 to +217 °F)
Storage Temperature:	–40 to +103 °C (–40 to +217 °F)
Vibration:	US MIL-STD-810, CAT 4., Figure 514C-1 Vertical (1.04 grms)
Shock:	US MIL-STD-810F, Method 516.5, Procedure 1, 5 g, 11 ms, sawtooth wave form
Valve Weight:	19 kg (42 lb)
Airborne Noise:	Wear ear protection while valve is operating
Electromagnetic Interference:	EN61000-6-4, 2007: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments, and EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
Ingress Protection	IP64

Electrical Characteristics

Dielectric Withstand:	1064 Vac from motor phases to Protective Earth (PE) ground; 500 Vac from all I/O to PE ground
Coil	
Coil Resistance:	0.54 ohms ±10% at 20 °C
Coil Inductance:	20 mH at 60 Hz
Insulation Resistance:	> 50 mΩ after dielectric test
DVP Input Voltage:	24Vdc nom. or 125 Vdc nom. (see DVP manual 26329)
Actuator Current:	3 A steady state, 8 A max. Expected transient current may be up to 20 A with a maximum of 20% duty cycle
Feedback Device—	
Type:	Frameless resolver (three-speed)
Excitation:	7 Vac at 4000 Hz
Return:	3.5 Vac at 4000 Hz

Steady State Performance Characteristics

Range of Maximum Metered Flow:	6804 kg/h (15,000 lb/h)
Range of Minimum Metered Flows:	91 kg/h (200 lb/h)
Fuel Supply Pressure Range-Normal Operation:	2000 to 12900 kPa (20 to 129 bar/290 to 1871 psig)
Max Inlet (Proof Pressure):	19.48 MPa (194.8 bar/2825 psig)
Min Burst Pressure:	64.5 MPa (645 bar/9355 psig)
Max Internal Fuel Leakage	27 kg/h (60 lb/h)
Nominal Diameter:	33 mm (1.312 inches)

Fuel Pressure Differentials

Nominal Regulated Metering Valve ΔP:	345 kPa (3.45 bar/50 psid)
ΔPressure Droop:	±6.9 kPa (±0.069 bar/±1.0 psid) w/ droop compensations in control
Total Differential Pressure:	P1 to PN 2000 to 12900 kPa (20 to 129 bar/290 to 1871 psid) For dynamic response, P1 to PN must be at least 4137 kPa (41.4 bar/600 psid).
Chip Shearing Force Capability:	134 N (30 lb force) minimum at the metering port edge
Flow Metering Accuracy:	±10% of point between 2.5% and 5% of max flow, ±5% of point, between 5% and 32.5% of max, ±3% of point above 32.5% of max flow using digital input and droop compensation in control (including all effects—valve position, ΔP, temperature)
Valve Positioning Stability:	Oscillations < ±0.05% of full stroke
Metered Flow Dynamic Response:	> 15 rad/s bandwidth (for ±2% of stroke)

Max Slew Time:	0.100 s (measured from 10 to 90% or 90 to 10%)

Liquid Fuel Types And Test Fluids

Operating Fuel Types:	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.
Fluid Inlet Temperature Range:	–40 to +103 °C (–40 to +217 °F)
Gravity Range:	0.650 to 0.900
Fuel Viscosity Range:	0.50 to 12.0 Centistokes
Inlet Fuel Filtration Levels:	Filter liquid fuel 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.

Operating Life

Mean Time Between Overhauls:	>50 000 operating hours
Cyclic Life:	>150 000 full stroke cycles
Total Design Life with Overhauls:	>150 000 operating hours
Storage Life:	>10 years, non-operating

Torque Values:

Electrical Cover Screws:	77–85 lb-in (8,7–9.6 N·m)

LQ Bypass Valve Specifications

Environmental Specifications

Operating Temperature:	–40 to +103 °C (–40 to +217 °F)
Storage Temperature:	–40 to +103 °C (–40 to +217 °F)
Vibration:	US MIL-STD-810C, Procedure 1, Table 514.2-ii, 20 Hz to 1000 Hz Figure 514.2-2, Curve J (5g)
Shock:	US MIL-STD-810C, Method 516.2, Procedure 1, 20 g, 11 ms, sawtooth wave form
Valve Weight:	17.7 kg (39 lb)
Airborne Noise:	Wear ear protection while valve is operating
Electromagnetic Interference:	EN61000-6-4, 2007: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments, and EN61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
Ingress Protection	IP64

Electrical Characteristics

Dielectric Withstand:	1064 Vac from motor phases to Protective Earth (PE) ground; 500 Vac from all I/O to PE ground

Coil

Coil resistance:	0.54 ohms ±10% at 20 °C
Coil inductance:	20 mH at 60 Hz
Insulation resistance:	> 50 mΩ after dielectric test
DVP Input Voltage	24Vdc nom. or 125 Vdc nom. (see DVP manual 26329)
Actuator Current:	3 A steady state, 8 A max. Expected transient current may be up to 20A with a maximum of 20% duty cycle

Feedback Device—

Type:	Frameless resolver (three-speed)
Excitation:	7 Vac at 4000 Hz
Return:	3.5 Vac at 4000 Hz

Steady State Performance Characteristics

Range of Bypass Fuel Flow:	< 45 to 13 608 kg/h (< 100 to 30 000 lb/h)
Range of Inlet Fuel Pressures:	1034 to 9653 kPa (10.3 to 96.5 bar/150 to 1400 psig) (normal operation)
Range of Bypass Fuel Pressure:	690 to 2070 kPa (6.9 to 20.7 bar/100 to 300 psig)
Maximum Differential Fuel Pressure:	8964 kPa (89.6 bar/1300 psig) (normal operation)
Valve Design Point Condition:	13 608 kg/h (30 000 lb/h) at Pinlet=1724 kPa (17.2 bar/250 psig), Preturn= 690 kPa (6.9 bar/100 psig)
Continuous Operational Condition:	4536 kg/h (10 000 lb)/h) at Pinlet=9653 kPa (96.5 bar/1400 psig), Preturn= 690 kPa (6.9 bar/100 psig)
Port Area vs Stroke Characteristic:	Approximately square law (triangular porting)
Proof Pressure Test Level:	19 MPa (193 bar/2800 psig)
Burst Pressure Test Level:	48 MPa (483 bar/7000 psig)
Maximum Internal Leakage:	<45 kg/h (100 lb/h) at Pinlet=9653 kPa (96.5 bar/1400 psig), Preturn= 690 kPa (6.9 bar/100 psig)
Maximum Leakage to Vent Port:	< 5 cm³/h at any condition. Based on the use of diesel fuel with a specific gravity of 0.810
Nominal Diameter:	33.3 mm (1.312 inches)
Flow Capacity:	Minimum flow < 45 kg/h (< 100 lb/h) at 8964 kPa (89.6 bar/1300 psid) Maximum flow > 13644 kg/h (>30,000 lb/h) at 1034 kPa (10.34 bar/150 psid)
Flow Versus Input	$\frac{W_{fb}}{\sqrt{P_{inlet} - P_{discharge}}} @ K_1 + K_2(x) + K_3(x)^2$

Signal Characteristics:	(as obtained from a triangular metering slot)
Pressure Loss:	At max position, the total pressure loss from inlet to outlet port connections is less than 1034 kPa (10.34 bar/150 psid) at 13 608 kg/h (30 000 lb/h) bypass flow

Liquid Fuel Types and Test Fluids

Operating Fuel Types:	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.
Test Fluid:	Calibration Fluid per US MIL-C-7024C Type II at –28 to +103 °C (–18 to +217 °F)
Fluid Inlet Temperature Range:	–40 to +103 °C (–40 to +217 °F)
Fuel Specific Gravity Range:	0.650 to 0.900
Fuel Viscosity Range:	0.50 to 12.0 Centistokes
Inlet Fuel Filtration Levels:	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.

Service Life and Reliability

Mean Time Between Overhaul (MTBO):	> 50 000 operating hours (target)
Total Operating Life With Overhauls:	> 200 000 operating hours (target)
Mean Time Between Failures:	> 50 000 operating hours (target; all defects)
Storage Life:	> 10 years, non-operating

Torque Values:

Electrical cover screws:	77–85 lb-in (8,7–9.6 N·m)
Outlet Fitting with Internal Cavitation Shield (bypass valve only):	95–105 lb-in (10.7–11.9 N·m)

Chapter 4. Maintenance

LQ25T Valve Maintenance

The valve assembly is designed to avoid the accumulation of air and fuel vapor in service (based on the use of diesel fuel with a specific gravity of 0.810) and does not require any action by the user to purge air or vapor from the assembly following installation or use on the engine system.

The valve is also designed such that during normal operation or storage, fuel or condensed water vapor does not accumulate within any part of the assembly in such a way as to cause damage or deterioration.

When removed from the engine system, it is possible to drain all fuel, condensed water vapor, or other contaminants from the assembly without further disassembly.

There are no field-replaceable parts on the LQ25T.

LQ Bypass Valve Maintenance

On the LQ Bypass Valve, the outlet fitting with its integrated cavitation shield and the 1.2 meter (4 ft) straight length of 51 mm (2 inch) diameter steel or stainless steel pipe (or tube) should be inspected for signs of cavitation damage at a maximum interval of 5000 hours of pump operation. Components showing significant signs of erosion should be replaced immediately and the system should be checked to ensure adequate back pressure is being maintained to the outlet of the valve.

The fitting connected to the outlet of the LQ Bypass must not be replaced with any other fitting. This fitting should be considered a part of the LQ Bypass Valve. Replacement of this fitting with a standard fitting will expose the fitting to cavitation erosion resulting in a hazardous condition with the potential to cause personal injury and/or damage to the fuel system and valve.

The valve assembly is designed so as to avoid the accumulation of air and fuel vapor in service (based on the use of diesel fuel with a specific gravity of 0.810) and does not require any action by the user to purge air or vapor from the assembly following installation or use on the engine system.

The valve is also designed such that during normal operation or storage, fuel or condensed water does not accumulate within any part of the assembly in such a way as to cause damage or deterioration.

When removed from the engine system, it is possible to drain all fuel, condensed water vapor, or other contaminants from the assembly without further disassembly.

The only field-replaceable part on the LQ Bypass Valve is the outlet fitting with integral cavitation shield.

Chapter 5.
Troubleshooting

⚠WARNING

The valve(s) may not fail shut in every situation. If the driver is unable to shut the valve in a fault situation, the valve will stay open. For safe turbine operation in fault situations, the valve must be used in conjunction with an additional high-speed shutoff valve. Also, the driver fault relay should be tied into the engine protection system.

⚠WARNING

Before attempting any troubleshooting action, verify that the prime mover is shut down and that fuel pressure is not present to valves that may open due to actuator motion.

Valve Problems

This troubleshooting section does not state the certain cause of any problem, nor does it cover all possible problems or all possible causes. This section will not enable a technician to locate a faulty component in the valve.

If an issue occurs, use Figures 5-1 and 5-2 (troubleshooting flowcharts) as a guide to locate and repair the problem. Follow the flow chart down from the title block to the next block. Rectangular boxes contain suggestions on where to look for a problem. Diamond-shaped boxes ask you questions based on the information you have gathered. The answer to that question will guide you to the next step in the troubleshooting procedure. By following the flowchart, you should be able to identify and correct most problems that may occur with the valve. If after following these troubleshooting procedures you are unable to find the cause of a problem and repair it, contact Woodward for assistance.

If the results of these procedures indicate that the valve may be faulty, replace the suspected unit with a valve known to be good to verify that the cause of the problem is in the valve.

To verify electrical connections within the valve, disconnect the electrical cables at the driver and measure resistances between driver connector terminals. Note that the following resistances are approximate and do not include tolerances. This test is to check for open or short circuits, and to test the wiring from the driver to the valve.

Motor Windings: Approximately 0.525 to 0.9 Ω
Resolver Connectors: These resistances apply to either resolver connector
EXC: Approximately 36.6 to 49.4 Ω
COS or SIN: Approximately 74.8 to 101.2 Ω

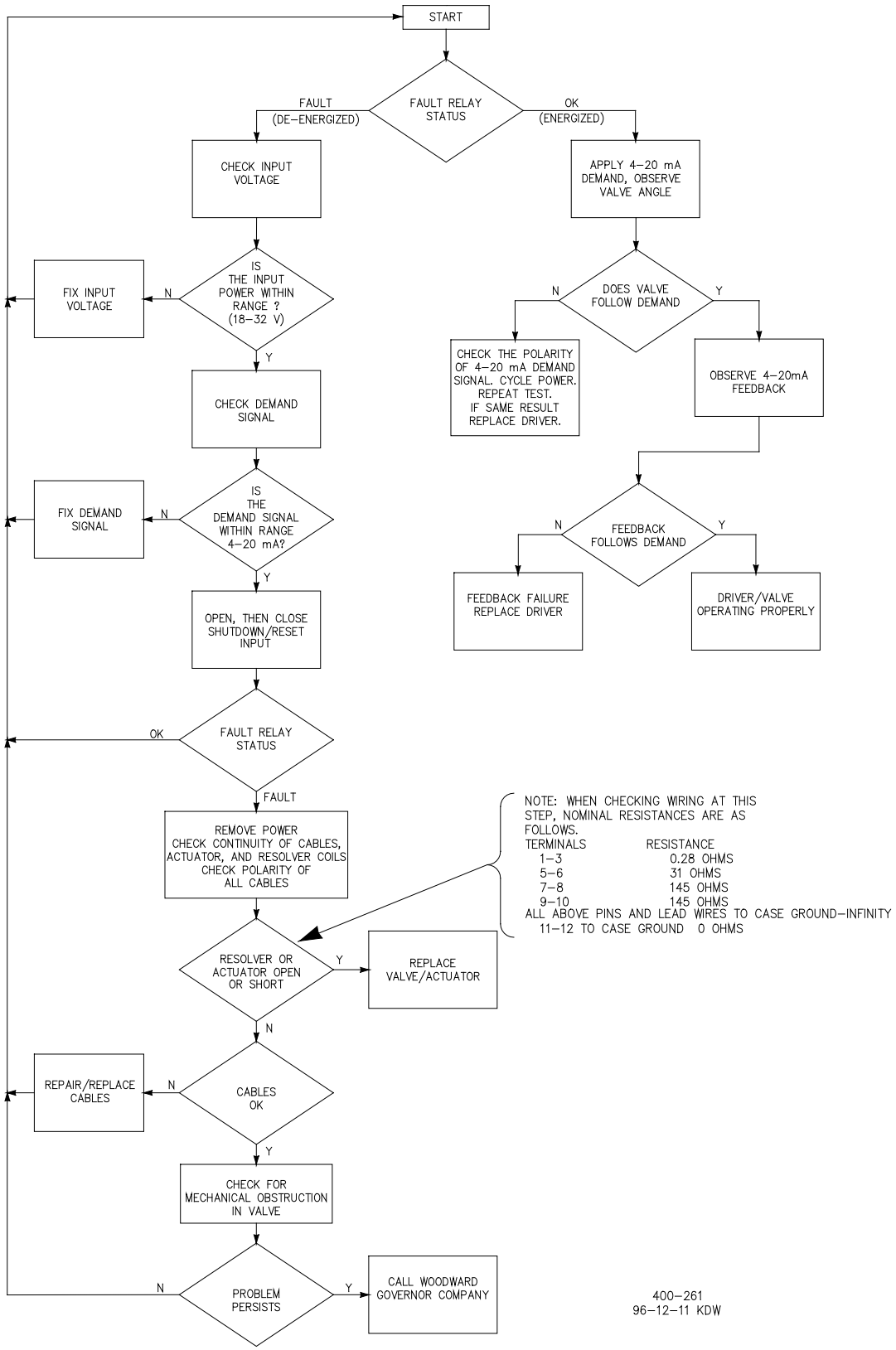


Figure 5-1. Troubleshooting Flowchart LQ Digital Driver

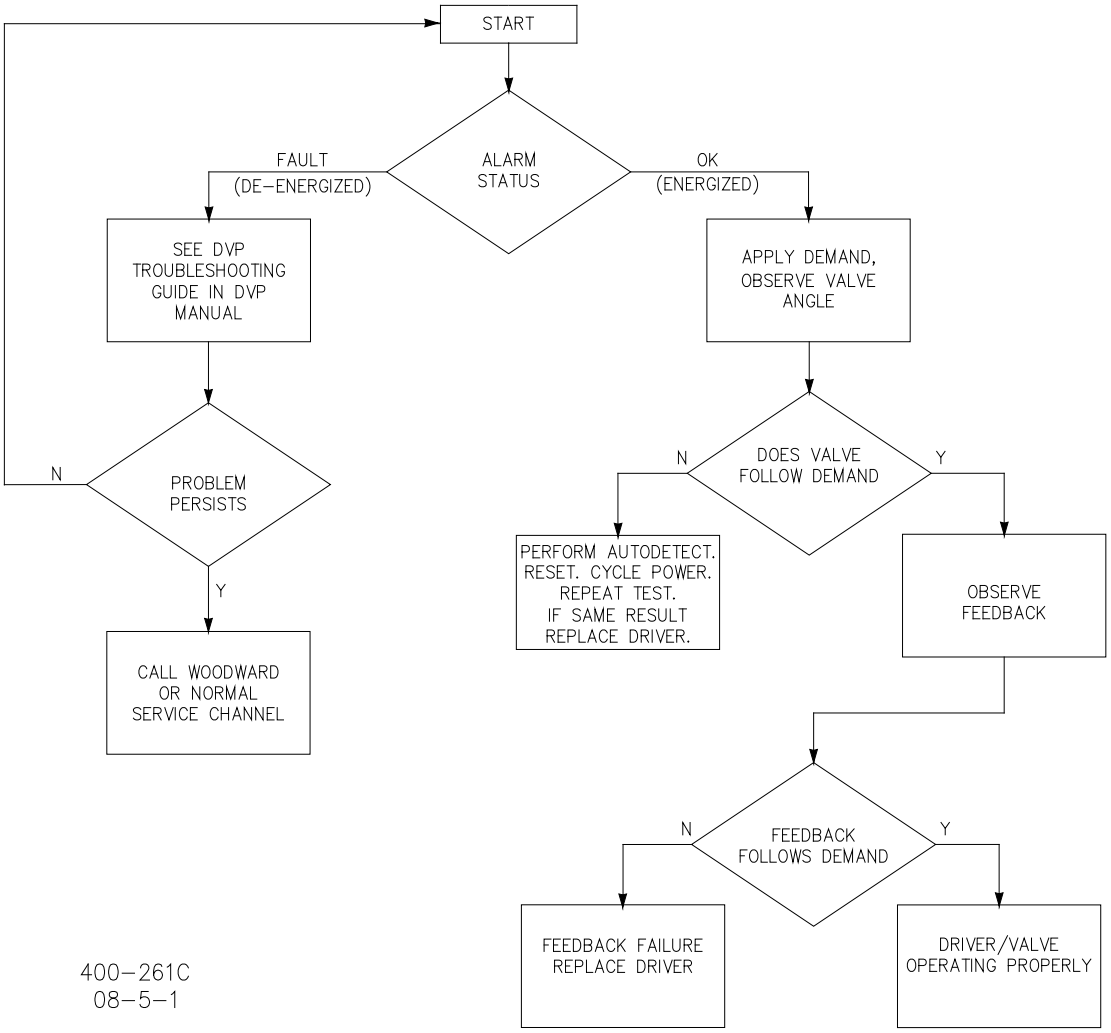


Figure 5-2. Troubleshooting Flowchart

Refer to DVP manual 26329 for troubleshooting.

Problem	Description	Remedy
Startup Position Error (Shutdown Position)	During the startup of the valve, the valve is closed to detect if the resolver is at the programmed position. If this is not so, the valve will shutdown.	Reset the valve, and the test will be performed again if the valve is Shutdown. Check if there is an obstruction in the valve. Check if the valve needs cleaning. Check pressure rating.
Position Error (Shutdown Position)	During run time, the valve will check if the position feedback and the demanded position are the same. If not, a position error will be flagged, and the valve will be shut down.	Check if there is an obstruction in the valve. Check if the valve needs cleaning. Check pressure ratings.
Tracking Error	The difference between the DeviceNet position demand and the Analog position demand is greater than the configured limit (1% default).	Check the control system analog output and the valve analog input.
Position Sensor Error (Shutdown Position)	The valve is continuously checking if the signals for the resolver are correct. If the resolver signals are missing or incorrect, a Position Sensor Error 1 is set.	Check wiring in the valve. Replace valve.

Chapter 6.
Product Support and Service Options

Product Support Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.

A current list of Woodward Business Partners is available at:
https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (Woodward North American Terms and Conditions of Sale 5-09-0690) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward North American Terms and Conditions of Sale 5-09-0690).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward North American Terms and Conditions of Sale 5-09-0690) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward North American Terms and Conditions of Sale 5-09-0690). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

Packing a Control

Use the following materials when returning a complete control:
- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- The part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- The unit serial number, which is also on the nameplate

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner**

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **https://www.woodward.com/support**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number

Prime Mover Information

Manufacturer _____

Turbine Model Number _____

Type of Fuel (gas, steam, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.)

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number

Symptoms

Description _____

_____

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Revision History

Changes in Revision E—
- Replaced both EU DoCs
- Removed PED certificate in Regulatory Compliance

Changes in Revision D—
- Update PED certificate number in Regulatory Compliance Section
- Replaced Declarations

Changes in Revision C—
- Revised both ATEX directives and the PED in the Regulatory Compliance section
- Added RoHS Directive to the Regulatory Compliance section
- Replace Ingress Protection title in 1 ¼-Inch Valve Specifications table
- Replaced Declaration

Changes in Revision B—
- Removed LQ25 designation where needed
- Added 1-Inch drawings; Figs 2-2c and 2-2d
- Added 1-Inch specification table to Chapter 3
- Added new DOC

Changes in Revision A—
- Updates to the Regulatory and Compliance Section
- Updated DOC/DOI installed
- Specification changes to Chapter 3

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00122-04-CE-02-06
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	LQ25 Throttling (LQ25T) / 9907-504. 9908-221, 9908-224, 9908-236 LQ25 Bypass (LQ25BP) / 9908-222, 9908-227
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment PED Category II Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)
Markings in addition to CE marking:	Ⓔx II 3 G Ex nA IIC T3 Gc
Applicable Standards:	ASME B31.3 Process Piping, 2004 ASME Boiler and Pressure Vessel Code VIII, Div. 1, 2004 ASME Boiler and Pressure Vessel Code II, Part D, 2004 EN IEC 60079-0:2018 - Electrical apparatus for explosive gas atmospheres – Part 0: General Requirements EN 60079-15:2010 - Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n' EN61000-6-2:2005 – Electromagentic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments EN61000-6-4:2007/A1:2011 – Electromagentic Compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
Conformity Assessment:	PED Module H – Full Quality Assurance CE-0062-PED-H-WDI 001-25-USA-rev-A Bureau Veritas SAS (0062) 4 Place des Saisons, 92400 COURBEVOIE, FRANCE

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Annette Lynch

Full Name

Engineering Manager

Position

Woodward, Fort Collins, CO, USA

Place

14-April-2025

Date

5-09-1183 Rev 43

EU DECLARATION OF CONFORMITY

EU DoC No.:	00122-04-CE-02-09
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	LQ25T with 1 in ports and ID module
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/68/EU (from July 19th, 2016) of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment. PED Category II Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (EMC)
Markings in addition to CE marking:	Ⓔx II 3 G, Ex nA IIC T3 Gc
Applicable Standards:	ASME Boiler and Pressure Vessel Code VIII, Div. 2, 2010 EN IEC 60079-0:2018 - Electrical apparatus for explosive gas atmospheres – Part 0: General Requirements EN60079-15:2010 - Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n' EN61000-6-2:2005 – Electromagentic Compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments EN61000-6-4:2007/A1:2011 – Electromagentic Compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments
Conformity Assessment:	PED Module H – Full Quality Assurance CE-0062-PED-H-WDI 001-25-USA-rev-A Bureau Veritas SAS (0062) 4 Place des Saisons, 92400 COURBEVOIE, FRANCE

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature	Annette Lynch
Full Name	Annette Lynch
Position	Engineering Manager
Place	Woodward, Fort Collins, CO, USA
Date	22 April 2025

5-09-1183 Rev 43

DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File name:	00122-04-CE-02-04
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Names:	LQ25T Valves LQ Bypass Valves
This product complies, where applicable, with the following Essential Requirements of Annex I:	1.1, 1.2, 1.3, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

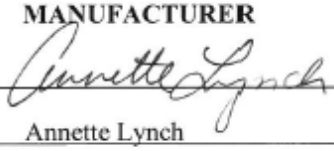
The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER



Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

8/11/2022
Date

Document: 5-09-1182 (rev. 16)

Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 26476.

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1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world.

Complete address / phone / fax / email information for all locations is available on our website.