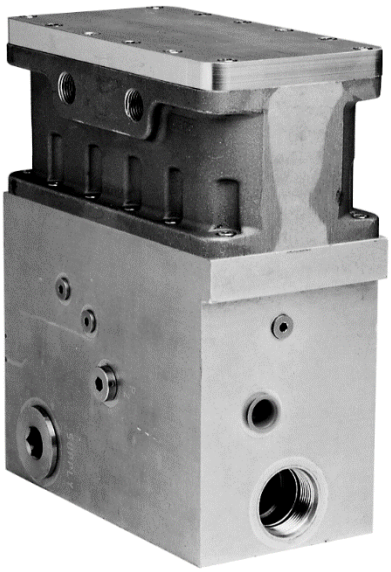
WOODWARD

Product Manual 26853
(Revision A, 8/2020)
Original Instructions



Liquid Shutoff Valve 25, SST (LSOV25 SST) Marine Stainless Steel

Installation and Operation Manual

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. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. 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. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

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

Manual 26853

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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 because these 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. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

International Compliance

IECEx: Certified for use in explosive atmospheres per Certificate:
IECEx CSA 15.0052X Ex d IIB T4 Gb

Marine Compliance (9908-355 stainless steel versions only):
Marine Type approval has been obtained on this product. The product has type approval for:

DNV-GL: DNV GL rules for classification – Ships Pt.4 Ch.6 Piping systems
DNV GL class programme CP-0186 – Type Approval of valves

ABS: Marine Main Propulsion and Electric Power Generation Applications - Liquid Fuel Shutoff Valve for Gas Turbine Engines 2016 Steel Vessels Rules

SIL Compliance:

LSOV25 Liquid Fuel Shutoff Valve – Certified SIL 3 Capable for fail-safe operation in safety instrumented systems. Evaluated to IEC 61508 Parts 1-7. Refer to the instructions of this Installation and Operation Manual, Chapter # 4 Safety Operations for LSOV25.
SIL Certificate WOO 1603100 C001

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

Special Conditions for Safe Use:

Wiring must be in accordance with international Zone 1, Category 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

The LSOV25 must be installed upright (with the electrical enclosure on top) to maintain an IP54 rating.

⚠CAUTION

Use supply wire suitable for at least 130°C.

⚠WARNING

Conduit seals must be installed within 18 inches (457 mm) of the conduit entry when the LSOV25 is used in Div. 1 or Zone 1 hazardous locations.

⚠AVERTISSEMENT

Les joints de conduit doivent être installés à moins de 457 mm (18 pouces) de l'entrée du conduit lorsque le LSOV25 est utilisé en Div. 1 ou zones 1 dangereuses

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

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

⚠ AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2 et/ou Zone 2.

⚠ WARNING

The shutoff valve is a critical component for protection against equipment failure and turbine overspeed. Routine inspection is necessary for the protection of the turbine and the turbine operators.

Chapter 1.
General Information

Shutoff Valve Description

The Woodward High Speed Liquid Fuel Shutoff Valve is a three-way, two-stage valve, designed to provide fuel bypass in 0.100 second or less after termination of the solenoid current. The valve is designed for fail-safe operation. Loss or termination of the electrical signal will result in all fuel delivery to the valve being bypassed to the return system.

A wash flow filter screen in the valve prevents contaminants in excess of 40 µm (nominal) from damaging the pilot-valve section.

The shutoff valve housing is constructed of stainless steel. All moving internal parts are hardened stainless steel.

There is no filtration of normal fuel flow through the valve.

The design of the shutoff valve protects the turbine should the normal fuel control become inoperative for any reason. Critical overspeed may occur should the valve fail to shut off fuel to the turbine. Engine overspeed can cause serious mechanical damage as well as personal injury or death.

Always use the shutoff valve to stop the turbine. This exercise provides proof of the proper operation of the safety equipment.

Because of the critical function of the valve, it is mandatory that the operator regularly monitor the valve whenever the turbine is shut down as well as during normal operation.

Woodward recommends the installation of two shutoff valves per API-616.

Specifications

Table 1-1. Electrical Requirements

Voltage Available:	Nominal 24 V (dc)
Power Consumption:	20 W nominal
Resistance to Ground:	10 MΩ minimum at 500 V (dc)
Dielectric Strength:	Leakage current less than 0.5 mA at 1000 V (ac) plus twice the rated solenoid voltage for one minute

Table 1-2. General Requirements

Fuel Compatibility:	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.
Fuel Viscosity:	Fuel viscosity must be between 0.5 cSt and 12.0 cSt
Fuel Cleanliness:	Filter liquid fuel to limit particulate size to 20 µm or smaller. Water and sediment must be limited to 0.1% by volume. Total particulate concentration must be limited to 2.64 mg/L of fuel.
Ambient Temperature:	(-29 to 119)°C / (-20 to 246)°F
Fuel Temperature:	(–29 to 119)°C / (-20 to 246)°F
Rated Flow:	13 608 kg/h (30 000 lb/h) based on US MIL-C-7024 calibrating fluid at 21 °C (70 °F)
Cycle Life:	10 000 cycles
Weight:	54.5 kg (120 lb.)
Construction:	Stainless Steel housing and enclosure with hardened stainless steel internal components
Fuel Connections:	Fuel inlet, fuel outlet, and bypass ports machined to accept –20 (SAE 070120) straight thread fittings. -04 (SAE 070120) straight thread for overboard drain on versions with proximity switch.
Nominal Diameter:	41 mm
Electrical:	0.500-14 NPTF conduit connector
Proximity Switch:	5 A, 250 V (ac), 60 Hz
Opening Time:	Maximum of 0.400 second after admission of fuel and solenoid current
Closing Time:	Within 0.100 s after the solenoid is de-energized with (690 to 8274) kPa / (100 to 1200) psig fuel applied to the inlet
Pressure Drop:	365 kPa (53 psig) inlet to discharge at 13 608 kg/h (30 000 lb/h) 958 kPa (139 psig) inlet to bypass at 13 608 kg/h (30 000 lb/h)
Internal Leakage Shutoff:	From inlet to discharge: None From inlet to bypass: 500 cm^3 maximum at 5516 kPa (800 psig)
Reverse Pressure Condition:	6206 kPa (900 psig)
Fluid Supply Pressure	
Maximum Working:	8274 kPa (1200 psig)
Proof:	12 411 kPa (1800 psig)
Burst:	41 370 kPa (6000 psig)
Maximum Bypass Pressure:	1724 kPa (250 psig)
Cracking Pressure:	690 kPa (100 psig) above reference pressure (bypass)

⚠WARNING

Conduit seals must be installed within 18 inches (457 mm) of the conduit entry when the LSOV25 is used in Zone 1 hazardous locations.

⚠WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Zone 1.

Chapter 2.
Installation

Receiving

The liquid fuel shutoff valve is tested with a non-corrosive liquid, drained and packed in a foam filled box for shipment. The unit may be stored for an extended period in the original container.

⚠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.

⚠WARNING

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the LSOV25.

⚠WARNING

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.

The stainless steel version is equipped with eyebolts designed for safe lifting. See figure 2.1 for the recommended method for how to lift the valve using the eyebolts and a lifting slings. Eyebolts provided to stainless steel version have a weight capacity of 400 lbs. per eyebolt. Use lifting straps with a weight capacity greater than the weight of the unit.

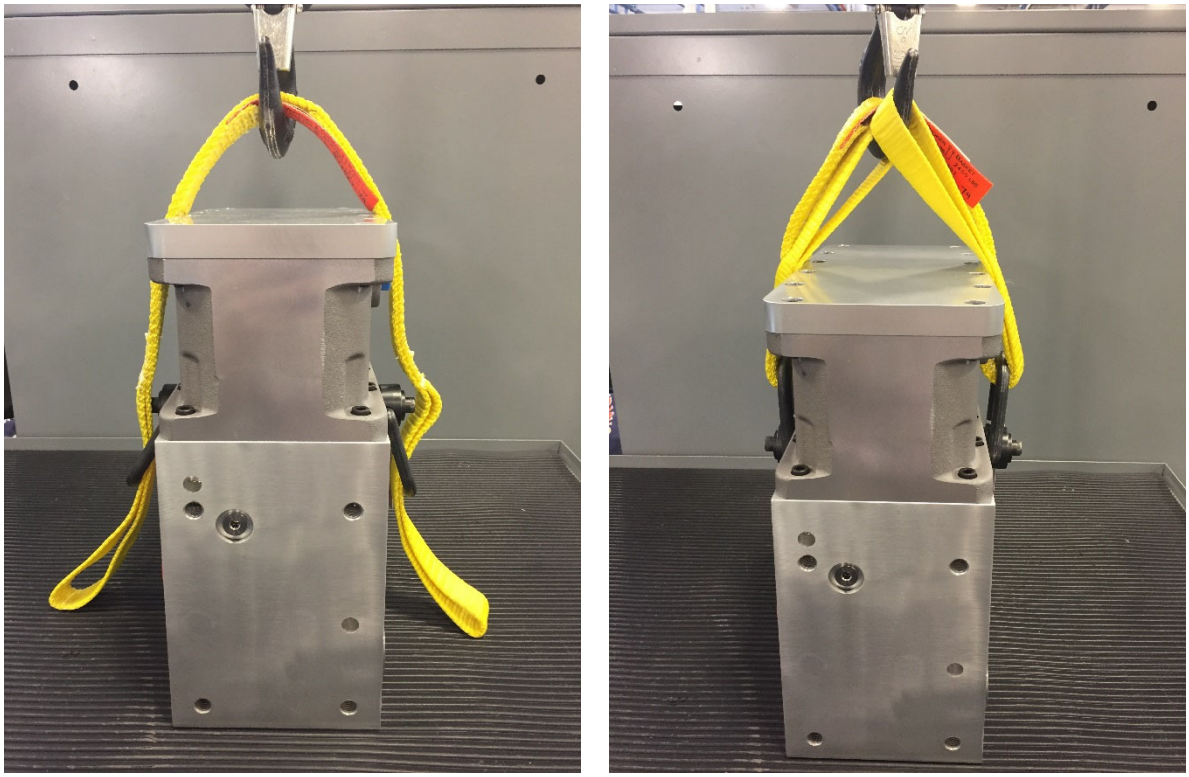


Figure 2-1. Lifting Sling Installation

⚠WARNING

Do not lift or handle the valve by any conduit. Lift or handle only ty using both eyebolts (Woodward part number 1113-1020)

⚠WARNING

SPECIAL CONDITIONS OF SAFE USE: The explosion protection of this product relies on the proper implementation of all applicable Special Conditions of Safe Use, as listed in the Regulatory Compliance chapter

Mounting

The valve is designed for installation in any attitude with four 3/8 inch bolts. (See the outline drawing for location of the mounting holes and of the valve.)

The LSOV25 must be installed upright (with the electrical enclosure on top) to maintain the IP54 rating.

1.625-12 UNF (-20) straight thread ports are provided for inlet, bypass and outlet pipe connections. When applicable, the "P2 main" port is supplied with a (-06) fitting. The bypass plumbing must be of equal size to the inlet and unobstructed to assure positive shutoff by the valve.

A 0.438-20 UNF (-04) straight thread port is provided for overboard drain connection on versions with proximity switch.

⚠WARNING

EXPLOSION HAZARD – Do not plug or restrict flow from the overboard vent ports. These vent ports must be connected to a drain header in a safe area.

Fuel Vent Port

There is a fuel vent port that must be vented to a safe location. In normal operation, this vent should have zero leakage. However, if excessive leakage is detected from this vent port, contact a Woodward representative for assistance.

⚠WARNING

EXPLOSION HAZARD – Do not plug or restrict flow from the overboard vent ports. These vent ports must be connected to a drain header in a safe area.

Electrical

⚠WARNING

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

Field wiring must be suitable for at least 130 °C. A 0.500 inch-14 NPTF conduit adapter is provided for the electrical connection. Connect the proper voltage to the two solenoid pins on the terminal block (see the outline drawing). Polarity is not important.

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 instructions in Figures 2-2a.

⚠WARNING

SWITCH INSTALLATION: For use in a Zone 1 environment, connect only resistive loads to the position switch (through the solenoid connector) that meet the limits of the Specifications Chapter. The making/breaking of highly inductive or capacitive loads has not been evaluated and may impair the suitability of the device.

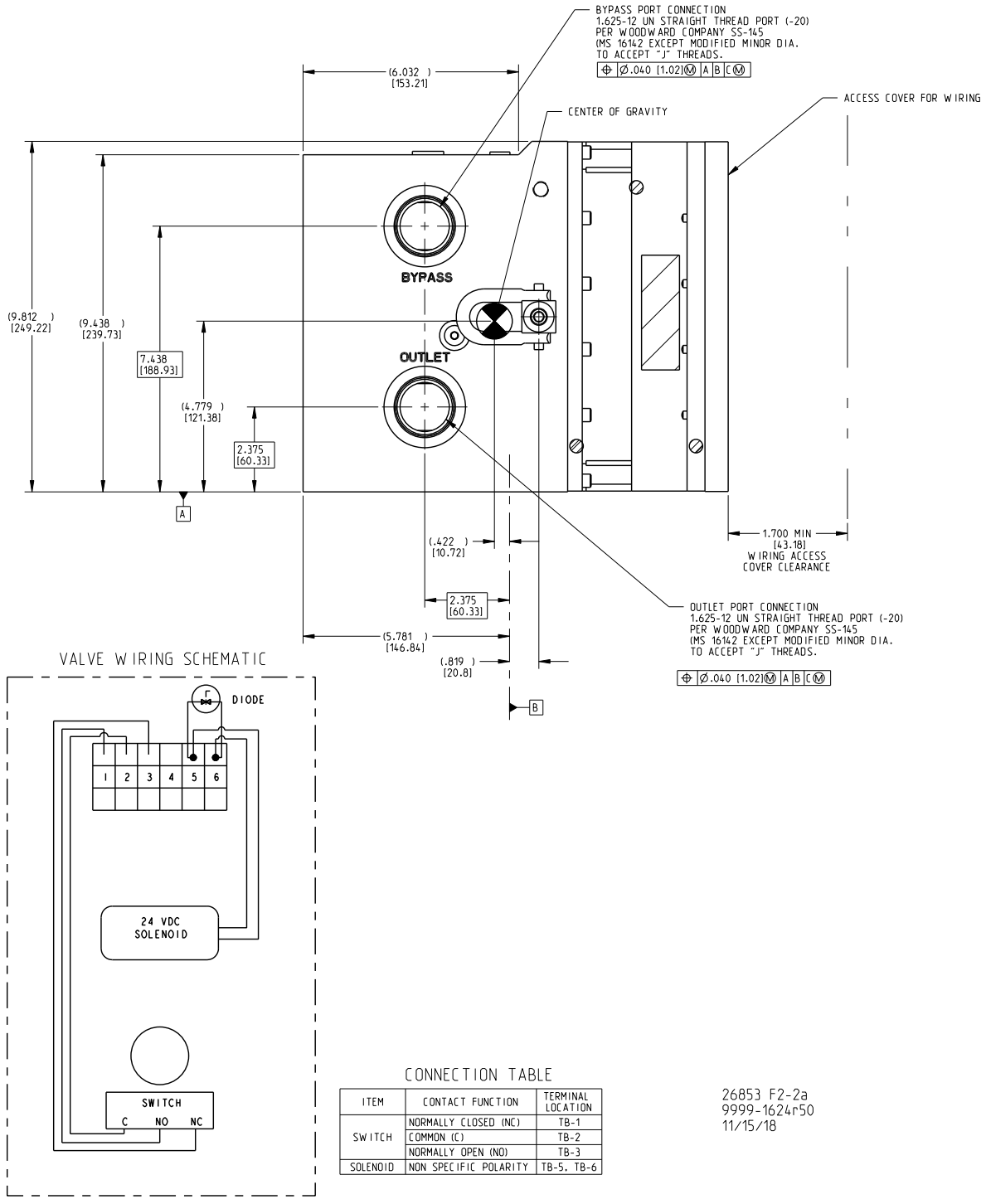
⚠CAUTION

All electrical connections must be properly assembled and secure to prevent an electrical hazard.

WARNING

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. To ensure there is no damage or contamination to the LSOV25 joint surfaces, inspect thoroughly.

Although there are functions in the LSOV25 that are not directly safety related, perform a functional test after the wiring and installation are complete. The functional check requires that liquid fuel supply flow is present at the LSOV25 valve Inlet port. Energize the LSOV25 solenoid valve and verify the valve opens as indicated by the position switch (if applicable) and a change in fuel flow from Bypass to Outlet. De-energize the solenoid and verify the valve closes as indicated by the position switch and a change in fuel flow from Outlet to Bypass.



CONNECTION TABLE

ITEM	CONTACT FUNCTION	TERMINAL LOCATION
SWITCH	NORMALLY CLOSED (NC)	TB-1
	COMMON (C)	TB-2
	NORMALLY OPEN (NO)	TB-3
SOLENOID	NON SPECIFIC POLARITY	TB-5, TB-6

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Figure 2-2a. Outline Drawing LSOV25, Stainless Steel, 24 VDC, w/Single Proximity Switch

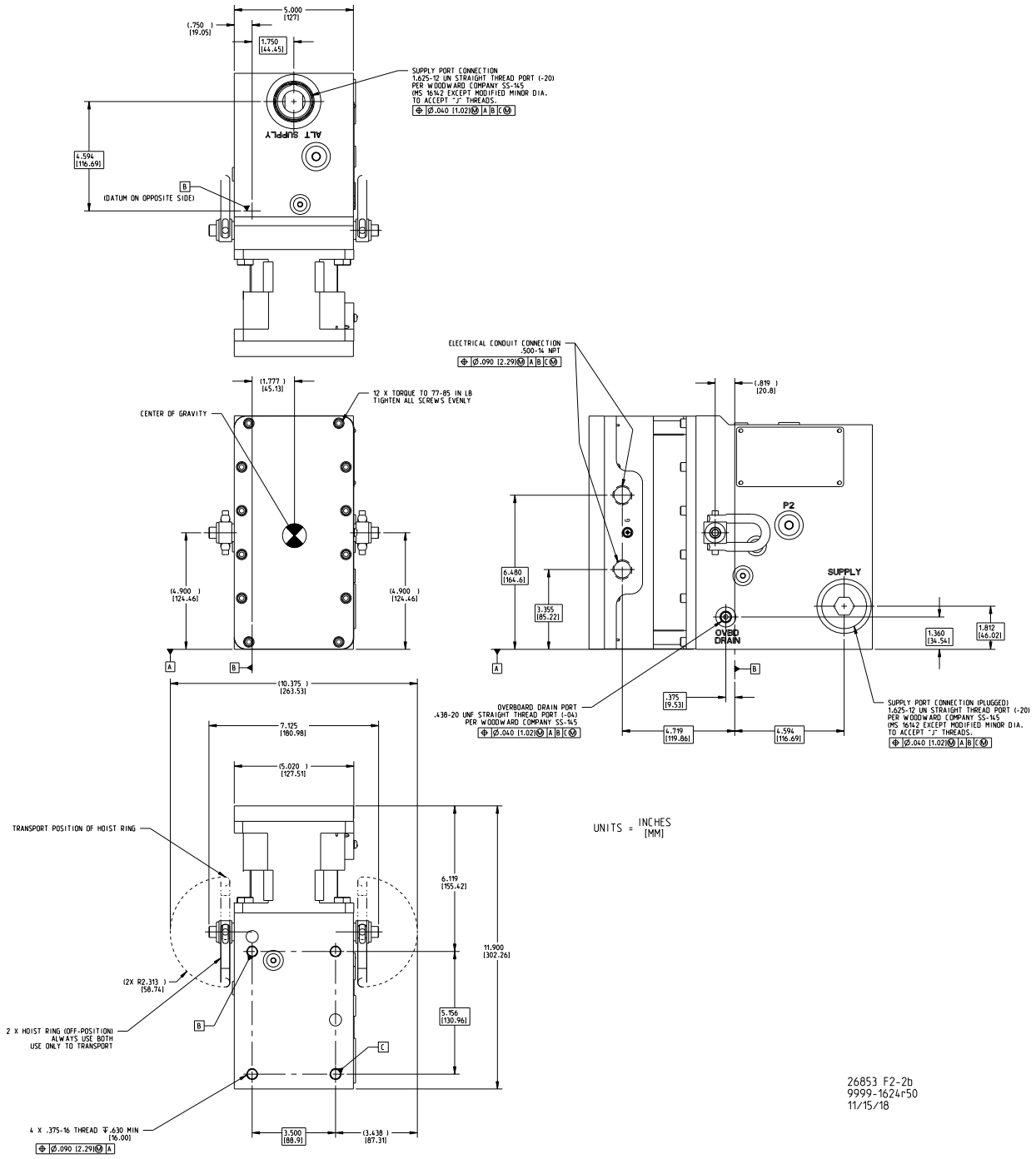

Figure 2-2b. Outline Drawing LSOV25, Stainless Steel, 24 VDC, w/Single Proximity Switch

Maintenance

⚠WARNING

Take care not to damage the cover or enclosure, the enclosure or valve housing threads and screws, or the valve housing threads while removing or installing the cover and enclosure.
The specified fastener torque is very important to ensure that the unit is properly sealed. The cover bolts must be tightened to (8.7 to 9.6) N·m / (77 to 85) lb-in

Recommended: Disassembly for cleaning and inspection every 10 000 cycles or three years of operation, whichever occurs first. In case of contamination of the interior passages, field disassembly and cleaning only by a trained service technician is authorized.

Routinely check the shutdown switches or relays to be sure that they are capable of interrupting the electronic signal to the shutoff valve.

A functional test of the LSOV25 is required after making any changes that affect the safety system. Although there are functions in the LSOV25 that are not directly safety related, perform a functional test after any change. The functional check requires that liquid fuel supply flow is present at the LSOV25 valve Inlet port. Energize the LSOV25 solenoid valve and verify the valve opens as indicated by the position switch (if applicable) and a change in fuel flow from Bypass to Outlet. De-energize the solenoid and verify the valve closes as indicated by the position switch and a change in fuel flow from Outlet to Bypass.

Always use the valve for routine shutdown as a check for continued operation.

The LSOV25 must be periodically leak tested to reveal dangerous faults that are undetected by automatic diagnostic tests. Perform this leak test at least once per year during shutdown conditions as follows:

1. Verify that the solenoid operator is de-energized and the valve is closed as indicated by the position switch (if applicable).
2. Verify that liquid fuel supply flow is present at the LSOV25 valve Inlet port. Verify that fuel flow is from Inlet to Bypass.
3. Throttle Bypass flow in order to raise Inlet pressure to 400 psig minimum, 1200 psig maximum. Check for leakage at the LSOV25 Outlet.

While the valve is closed, check for excessive leakage, either through the valve or through the vent. Any leakage through the valve to the turbine is proof of wear and/or possible malfunction. When there is proof of wear, immediately replace and return the valve for factory service.

You can expect a minimal amount of leakage through the bypass connection of the valve. When the volumes of leakage changes appreciably, replace the valve and return to a service facility.

⚠WARNING

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. To ensure there is no damage or contamination to the LSOV25 joint surfaces, inspect thoroughly.

NOTICE

FREEZING HAZARD: Fluid supply lines should be thoroughly flushed prior to storage of the LSOV25 to prevent freezing damage.

⚠WARNING

Remove electrical power and pressure prior to performing any maintenance.

Chapter 3.
Principles of Operation

The shutoff valve is designed to be the last element in the fuel-supply line to the turbine. Its rapid closure time of less than 0.1 second, and opening time of 0.4 second, makes it an ideal valve for both routine and emergency shutoff of the fuel supply to the controlled device.

In the full open (valve energized) mode, a very small amount of leakage will occur to bypass. Termination of the electrical signal will result in all fuel delivery to the valve being bypassed to the fuel return system.

Fuel pressure and flow must be present to ensure proper operation of the valve. Springs on the control plunger in the valve will cause the valve to close itself should the fuel flow drop below a nominal amount.

The regulator generates a working pressure within the valve. In the de-energized state, the working pressure supplements the return spring force on the outlet piston to provide a positive no-leak seal at the turbine fuel manifold. This ensures rapid shutdown capability and prevents nozzle contamination when dual-fuel turbines are operated on gaseous fuel.

When energized, the first stage solenoid valve directs full pressure to the bottom of the bypass piston and away from the bottom of the outlet piston. The combination of fuel pressure and spring pressure drives the bypass piston up. This closes the bypass port and drives the outlet piston away from the seal, opening the fuel passage through the valve to the turbine.

As soon as fuel system pressures reach 690 kPa (100 psi) above bypass (reference) pressure, the outlet piston opens completely. This results in a minimum pressure drop through the valve and assures that maximum fuel flow can be achieved through the valve.

When the electrical signal is removed from the solenoid inlet pressure is directed below the outlet piston. Simultaneously, the pressure below the bypass piston is vented to bypass. The combination of fuel pressure and spring pressure drives the outlet piston tightly against the seal and allows the bypass piston to open, allowing fuel to return to the supply system.

A 40 µm wash-flow filter is provided between inlet pressure and the solenoid control valve to assure trouble free operation of the shutoff valve. In the shutoff position all inlet flow is directed to bypass. This prevents buildup of pressure in the positive-flow fuel system which could cause damage to the pump or plumbing. For optimum dynamic response, it is important that the bypass fuel plumbing be sized large enough to accommodate the maximum expected pump delivery with less than 1724 kPa (250 psi) head measured at the valve bypass port. Also, inlet pressure should be at least 690 kPa (100 psi) higher than bypass pressure in all operating conditions.

Polarity is unimportant in the dc operated valve.

The maximum power consumption of the valve is 25 W. A bipolar Zener diode is provided in the solenoid wiring to prevent voltage spikes during operation and to prevent the generation of electromagnetic interference (EMI).

Chapter 4.
Safety Operations for LSOV25

Product Variations Certified

The SIL rated LSOV25 Liquid Shutoff Valve is designed and certified to the functional safety standards according to IEC61508. Reference SIL certificate WOO 1603100 C001. Contact Woodward for a copy of the SIL certificate.

The functional safety requirement in this manual applies to all LSOV25 Liquid Shutoff Valves. The SIL rated valves will have a DU FIT of less 765 for Full Stroke versions.

The LSOV25 Liquid Shutoff Valve is certified for use in applications up to SIL 3 according to IEC 61508.

The LSOV25 Liquid Shutoff Valve is designed to provide fast shutoff of liquid fuel flow to an industrial gas turbine.
Fuel flow to the engine is stopped when the valve is closed (de-energized), with zero leakage from the inlet to the outlet. The fuel inlet flow to the LSOV25 is directed to Bypass which leads back to the fuel pump or fuel reservoir.

The following version was considered in the FMEDA of the LSOV25 Liquid Shutoff Valve:

LSOV25 Liquid Shutoff Valve, Full Stroke: State where the valve is closed (de-energized) with fuel flow being directed from Inlet to Bypass. Fuel flow from Inlet to Outlet is closed.

SFF (Safe Failure Fraction) for the LSOV25

The LSOV25 is only one part of a shutoff system that supports an over-speed shutdown SIF (Safety Instrumented Function). This system consists of a speed sensor, a processing unit, and a fuel shutoff actuation sub-system of which the LSOV25 is a component.

The SFF (Safe Failure Fraction) for each subsystem should be calculated. The SFF summarizes the fraction of failures which lead to a safe state plus the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action. This is reflected in the following formulas for SFF:

$$SFF = \lambda_{SD} + \lambda_{SU} + \lambda_{DD} / \lambda_{TOTAL}$$

where $\lambda_{TOTAL} = \lambda_{SD} + \lambda_{SU} + \lambda_{DD} + \lambda_{DU}$

The failure rates listed below, for only the LSOV25, do not include failures due to wear-out of any components. They reflect random failures and include failures due to external events such as unexpected use. Reference the FMEDA: WOO 16-03-100 R001 for detailed information concerning the SFF.

Table 4-1. Failure Rates according to IEC61508 in FIT

Device	λ_{SD}	λ_{SU}[2]	λ_{DD}	λ_{DU}
Full Stroke	0	705	0	765

The LSOV25 Liquid Shutoff Valve is a Type A device. According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1H approach according to 7.4.4.2 of IEC 61508 or the 2H approach according to 7.4.4.3 of IEC 61508. The 1H approach should be used for the LSOV25.

Response Time Data

The LSOV25 full stroke response time to close is as follows: less than 100 ms @ 1200 psig (8274 kPa) fuel pressure.

Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the useful life of the LSOV25 is 10,000 cycles.

Management of Functional Safety

A Failure Modes, Effects and Diagnostic Analysis is one of the steps to be taken to achieve functional safety certification per IEC 61508 of a device. From the FMEDA, failure rates are determined. The FMEDA that is described in this report concerns only the hardware of the LSOV25 Liquid Shutoff Valve. For full functional safety certification purposes, consider all requirements of IEC 61508.

Restrictions

The user must complete a full functional check of the LSOV25 after initial installation, and after any modification of the overall safety system. No modification shall be made to the LSOV25 unless directed by Woodward. This functional check should include as much of the safety system as possible, such as sensors, transmitters, actuators, and trip blocks. The results of any functional check shall be recorded for future review.

The LSOV25 must be used within the published specification in this manual.

Competence of Personnel

All personnel involved in the installation and maintenance of the LSOV25 must have appropriate training. Training and guidance materials are included this manual.

These personnel shall report to Woodward any failures detected during operation that may affect functional safety.

Operation and Maintenance Practice

A periodic leak test of the LSOV25 is required to verify proper operation. More information is in the “Yearly Leak Test” section below. The frequency of the leak test is determined by the overall safety system design, of which the LSOV25 is part of the safety system. The safety numbers recorded in the following sections assist the system integrator determine the appropriate test interval.

The LSOV25 requires no special tools for operation or maintenance.

Installation and Site Acceptance Testing

Installation and use of the LSOV25 must conform to the guidelines and restrictions included in this manual. No other information is needed for installation, operation, and maintenance.

Functional Testing after Initial Installation

A functional test of the LSOV25 is required prior to use in a safety system. This should be done as part of the overall safety system installation check. For guidance on the functional test, see the procedure below.

Functional Testing after Changes

A functional test of the LSOV25 is required after making any changes that affect the safety system. Although there are functions in the LSOV25 that are not directly safety related, recommend you perform a functional test after any change. The functional check requires that liquid fuel supply flow is present at the LSOV25 valve Inlet port. Energize the LSOV25 solenoid valve and verify the valve opens as indicated by the position switch (if applicable) and a change in fuel flow from Bypass to Outlet. De-energize the solenoid and verify the valve closes as indicated by the position switch and a change in fuel flow from Outlet to Bypass.

Yearly Leak Test

The LSOV25 must be periodically leak tested to reveal dangerous faults that are undetected by automatic diagnostic tests. Perform this leak test at least once per year during shutdown conditions as follows:

1. Verify that the solenoid operator is de-energized and the valve is closed as indicated by the position switch (if applicable).
2. Verify that liquid fuel supply flow is present at the LSOV25 valve Inlet port. Verify that fuel flow is from Inlet to Bypass.
3. Throttle Bypass flow in order to raise Inlet pressure to 400 psig minimum, 1200 psig maximum. Check for leakage at the LSOV25 Outlet. Any continuous measureable leakage may indicate valve seat wear or a possible malfunction. If you detect leakage, return valve to Woodward for service.

Chapter 5.
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 **www.woodward.com/directory**.

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 (5-01-1205) 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 Product and Service Warranty 5-01-1205).

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 Product and Service Warranty 5-01-1205) 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 Product and Service Warranty 5-01-1205). 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 us via telephone, email us, or use our website: **www.woodward.com**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, 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) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+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) 6762 6727
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) 6762 6727
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

Revision A —

- Added SIL 3 Certification information to Regulatory Compliance Section
- Added Chapter 4 Safety Operations for LSOV25

New Manual —

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Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26853.

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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.