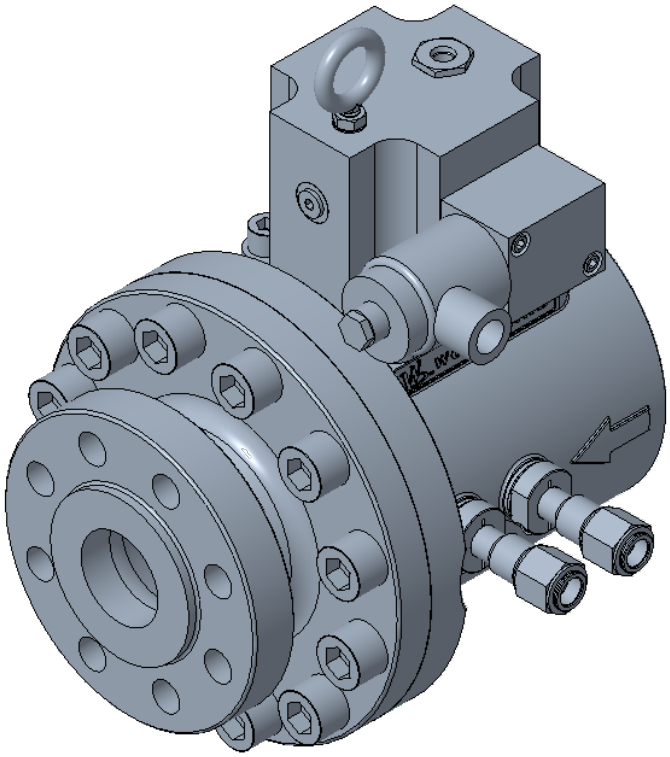
WOODWARD

Product Manual 35229
(Revision 50, 3/2026)
Original Instructions



Gas Shutoff Valve
GSOV50 H2 - 2 in (50 mm)

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. 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.

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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.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

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

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

ATEX – Potentially Explosive Atmospheres 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 II Category 3 G/ Ex db ec h IIC T3 Gc

Pressure Equipment Directive: Directive 2014/68/EU on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment.
Product Type/Size: DN 50mm PED Category II
PED Module H – Full Quality Assurance.

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

RoHS Directive Woodward Turbomachinery Systems products are intended exclusively for sale 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
These listings are limited only to those units bearing the appropriate identification marks.

IECEx: Certified for use in explosive atmospheres per Certificate:
IECEx ETL 25.0030 **Zone II Category 3 G/ Ex db ec h IIC T3 Gc**

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

CSA & UL: Compliant for North America per the compliance of the individual components below:
Solenoid Valve – Class I, Div 2, Groups A, B, C and D, T3, CSA Certificate 1260548
Proximity Switch – Class I, Div 2, Group A, B, C and D, T3 UL E79070.

Special Conditions for Safe Use

Special Conditions for Safe Use:
Wiring must be in accordance with North American Class I, Division 2, or European or other international Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.
Specific conditions from the relevant certificates:

IECEx:

- The leads of the electrical components shall be terminated only in a non-hazardous area or within an enclosure suitably certified for the intended hazardous area classification.
- When electrical components interface with a metal conduit system, a reliable low-resistance connection to earth shall be ensured.
- Prior to start-up, the gas turbine fuel system shall be purged with inert gas (nitrogen) to ensure that no oxygen remains within the system.
- The GSOV50H2 shut-off valve shall only be used within the specified temperature limits.
- The maximum permissible process fluid temperature shall not exceed 177 °C, and the maximum permissible ambient temperature shall not exceed 121 °C.

Field wiring must be suitable for at least 125 °C (250 °F).
Connect ground terminal to earth ground.
Ambient temperature range: GSOV50 H2: –20 to +121 °C

⚠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 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 ou Zone 2.

⚠WARNING

POTENTIAL ELECTROSTATIC CHARGING HAZARD INSTRUCTIONS

The risk of electrostatic discharge for painted units is reduced by permanent installation, proper connection of the equipotential ground lugs, and care when cleaning. Painted units must not be cleaned or wiped off/against unless the area is known to be non-hazardous.

Safety Symbols


Direct current


Alternating current


Both alternating and direct current


Caution, risk of electrical shock


Caution, refer to accompanying documents


Protective conductor terminal


Frame or chassis terminal

Chapter 1.
General Information

Introduction

The GSOV50 H2 is a high-speed fuel isolation valve designed to terminate the turbine fuel supply should the electronic fuel control or sequencer interrupt the permissive electrical signal.

IMPORTANT

Shutoff valves in this manual are not intended to be used as automatic safety shutoff valves, where they would be relied on for fire suppression or loss of life prevention. These valves are intended to be used as a fast-acting fuel shutoff valves, installed downstream of the safety shutoff valve(s), to prevent overspeed or other damaging events to the turbine.

The gas supply plumbing must ***not*** be pressure tested using water, as this may lead to damage of the fuel isolation valve and prevent proper actuation.

Because of the critical function of this component, it is mandatory that the turbine operators regularly monitor the condition of the valve. It should be inspected regularly during all turbine maintenance intervals.

To verify proper operation during shutdown conditions:

- Ensure that the solenoid operator is de-energized.
- Ensure that the actuation air supply pressure present at the actuation inlet port is within the specified range of 80 to 140 psig (5.52 to 9.65 bar).
- Check for leakage through the main valve mechanism by measuring the leakage flow rate from the overboard connections. Leakage in excess of 100 cm^3/min may indicate valve wear or a possible malfunction.

GSOV Valve Description

The GSOV50 H2 is a normally closed, three-stage device, designed to terminate fuel flow in maximum 100 ms at fuel pressures per ASME B16.34 class 600, materials group 2.2, after interruption of the electrical supply current. Valve closure is due to the stored energy of a coiled spring in the final stage.

The valve is compatible with most gaseous fuels, including natural gas, propane, ethane, and methane, and is fully capable of handling up to 100% hydrogen. All-stainless-steel components, along with Polymide and PTFE seal materials, are designed to accommodate the chemical constituents typical of the fuel types listed in the specifications table.

An integral 40 µm (nominal) filter screen protects the first and second stage components from damage due to particulate contamination. The fuel shutoff valve is constructed of corrosion-resistant materials.

The valve weighs 108.8 lbs (49.4 kg).
The valve will positively seal in a reverse-pressure condition up to 500 psig (34.48 bar).

The GSOV valve is designed to be NACE compliant per ANSI/NACE MR0175/ISO 15156, Petroleum and Natural Gas Industries - Materials for use in H_2S-containing environments in oil and gas production.

The GSOV50 H2 is compliant to ASME B31.3-2024, Chapter VIII for inclusion in a Category M Fluid Service piping system.

GSOV Actuation System

The GSOV50 H2 Actuation System is a subassembly of the electrical components necessary to control the shutoff valve, which includes the solenoid valve and proximity switches. See the installation section for relevant information on each component.

GSOV50 H2 Preliminary Specifications

Description:	Pneumatically actuated gas shutoff valve
Closing Time:	Less than 100 ms
Opening Time:	Less than 300 ms
Valve Seat Leakage:	ANSI/FCI 70-2-2013 Class VI forward and reverse
Design Life:	20 000 cycles
Nominal Pipe/Flange Size:	2” (DN 50 mm) Class 600, CF8M, Raised Face per ASME B16.5 except with 8X 0.625-11 tapped holes
Valve Effective Area (ACd):	2.4 in^2 (1548 mm^2) - See page 24 for definition
Valve Weight:	108.8 lb (49.4 kg)
Fuel Compatibility:	Fuels with H2 (hydrogen) blend up to 100%, natural gas, propane, ethane, methane, or other typical gas fuels
Required Fuel Filtration:	Less than or equal to 10 µm: 30 ppm by volume maximum Greater than 10 µm: 0.3 ppm by volume maximum
Allowable Actuation medium:	Air, Nitrogen
Actuation Air Filtration for Solenoid:	40 µm
Min Gas Fuel Temperature (TS):	-4 °F (-20 °C)
Max Gas Fuel Temperature (TS):	350 °F (177 °C)
Ambient Temperature Range	-4 to +250 °F (-20 to +121 °C)
Allowed Actuation Pressure Range:	80 to 140 psig (5.52 to 9.65 bar)
Min Hold Open Actuation Pressure:	Approx. 60 psig (4.14 bar)
Max Allowed Gas Fuel Pressure:	900 psig (62.05 bar)
Proof Test Pressure:	1350 psig (93.08 bar)
Design Burst Pressure:	4500 psig (310.26 bar)
Max Allowed Reverse Gas Pressure:	500 psig (34.47 bar)
Max Overboard Vent Back Pressure:	50 psig (3.45 bar)
Max Overboard Vent Leakage:	20 cm^3/min as new Up to 100 cm^3/min at end of life At ambient temperatures -4ºF (-20ºC) leakage may be higher
Solenoid Input Voltage Models (absolute min/max):	18-32 Vdc (24 Vdc nominal) or 90-140 Vdc (125 Vdc nominal)
Solenoid Power Consumption:	17 W at 20 °C, max voltage 10 W at 20 °C, nominal voltage
Solenoid Typical Resistance:	24 Vdc model: 56 Ω 125 Vdc model: 1.5 kΩ
Proximity Switch Contact Rating:	0.5 A @ 125 VDC

IMPORTANT

If the GSOV50 H2 valve is installed outside where icy conditions may occur, consider replacing the vent breather plug with heat–traced vent tube. This will help prevent clogging of the vent breather passage. If the vent breather passage becomes clogged, the valve may fail to open.

Service Life Capabilities and Limitations

If properly installed, maintained, and operated within its design limits, the GSOV50 H2 will operate up to 50 000 hours or up to 20,000 cycles before requiring repair or overhaul.

Periodically check for leakage at the main seat and overboard vent. Excessive leakage may indicate seal wear and require servicing.

The main seat is designed to meet ANSI/FCI 70-2 Class VI leakage standards. Depending on the cleanliness of the operating fluid, some degradation to Class V is considered acceptable. The recommended service threshold is when forward seat leakage exceeds Class V limits. Beyond this level, the valve should be overhauled.

IMPORTANT

Leakage rates for the GSOV50 H2 are specified based on air testing. Higher leakage rates may be expected when operating with fuel gases.

Chapter 2.
Installation and Maintenance

Receiving

The GSOV50 H2 gas fuel isolation valve is tested with dry air and shipped in a foam-filled box. The unit may be stored for an extended period in its original packaging.

Lifting

⚠WARNING

Carefully review Figure 2-1 for lifting points, weight, and center of gravity before moving the valve. Do not lift or handle the valve by its electrical components. When placed on a flat surface, the valve may roll and become unstable.

Due to its weight, the valve poses a crushing hazard that can cause serious injury or death. Rolling or dropping may also damage its components.

⚠WARNING

Do not lift or handle the GSOV50 H2 using any conduit. Only the designated lifting eye is approved for lifting or handling the unit.

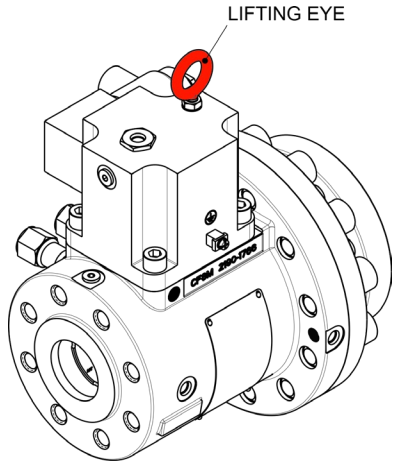


Figure 2-1. Lifting Eye Location

Use appropriate lifting equipment during installation. The valve's lifting eye is rated for 1000 lb in an in-line lift. Do not exceed a 60° angle from vertical without additional support. If using extra straps, ensure they do not contact or damage electrical components.

IMPORTANT

If re-installation of a lifting eye is required, it shall be screwed in to a minimum depth of 0.6 inch (15 mm). The lock nut shall then be tightened to a torque of 160 to 210 LBIN (18 to 24 Nm).
The lifting eye shall have a minimum rated capacity of 1000 lb.

Installation

⚠WARNING

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

⚠WARNING

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the GSOV50 H2 to prevent temporary or permanent hearing loss.

⚠WARNING

The valve has a high spring force and sharp elements. To prevent serious injury, do not place hands or fingers inside the valve when the ports are exposed.

⚠CAUTION

This product contains preloaded springs that work to close the valve upon loss of power. To prevent bodily harm, do not disassemble any part of the product unless instructed to do so in these instructions.

IMPORTANT

GSOV50 H2 connection piping systems should be designed and installed by a qualified person with specific training and experience in hydrogen piping systems.

IMPORTANT

The piping system, as well as any auxiliary instrumentation connected to the Gas Shutoff Valve (GSOV), shall be designed with respect to process fluid (fuel) to be used inside the valve. Special caution must be taken when hydrogen or hydrogen blends are used as fuel.

⚠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.

⚠WARNING

External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy an applicable requirement(s) for their system.

The GSOV50 H2 valve is designed for installation between two standard 2-inch (50 mm), 600-pound (272 kg) flanges per ANSI B16.5.

ASTM/ASME grade bolts/studs should be used to install the valve into the process piping. The length and diameter of the bolts and studs shall conform to ASME B16.5 according to the valve flange size and class. The thread size of the bolts/ studs is 0.625-11 UNC per ASME B1.1.

The discharge flange has eight 0.707 inch (18 mm) through-holes.

Flange gasket materials shall conform to ASME B16.20. The user shall select a gasket material capable of withstanding the anticipated bolt loading without harmful crushing and suitable for the intended service conditions.

When installing the valve into the process piping, it is important to properly torque the studs/bolts in the appropriate sequence in order to keep the flanges of the mating hardware parallel to each other. A two-step torque method is recommended. Once the studs/bolts are hand-tightened, torque the studs/bolts in a crossing pattern to half the required torque. Once all studs/bolts have been torqued to half the appropriate value, repeat the pattern until the rated torque value is obtained.

Allowable Piping Loads

Typical piping loads have been used in the design of the housing to ensure that there is not an adverse effect from the stresses applied to the housing from the inlet and outlet piping.
These loads, used in the design analysis of the housings, are not to be exceeded.

Table 2-1. Piping Loads According to Valve Size

Valve Size	Max Pipe Axial Force	Max Pipe Shear Force	Max Pipe Moment	Max Flange Bolt Force (Per Bolt)
50 mm (2 inch)	3599 N (809 lbf)	3599 N (809 lbf)	2199 N·m (1622 lb-ft)	29016 N (6523 lbf)

The 0.438-20 (-04) port, located on the top of the inlet flange, is provided as a pressure tap. In systems where redundant fuel isolation valves are used, the port may be connected to a normally open vent valve. This arrangement will relieve trapped fuel pressure between the fuel isolation valves as well as any leakage that may occur across the first fuel isolation valve.

Overboard Connections

The two 0.438-20 (-04) ports, located on the side of the inlet and outlet flange, are provided as a overboard vent connection. Securely connect overboard vent ports located on the side of the housing to the process fuel vent system. Never plug or restrict flow from overboard ports.

During opening transients, flow can be expected from the vent port. During steady-state operation (open or closed) flow from the vent port should not exceed 100 cm^3/min. Flow in excess of this may be a sign of primary-seal or pilot-stage leakage. **Back pressure on the vent connection should not exceed 50 psig (3.45 bar)** .

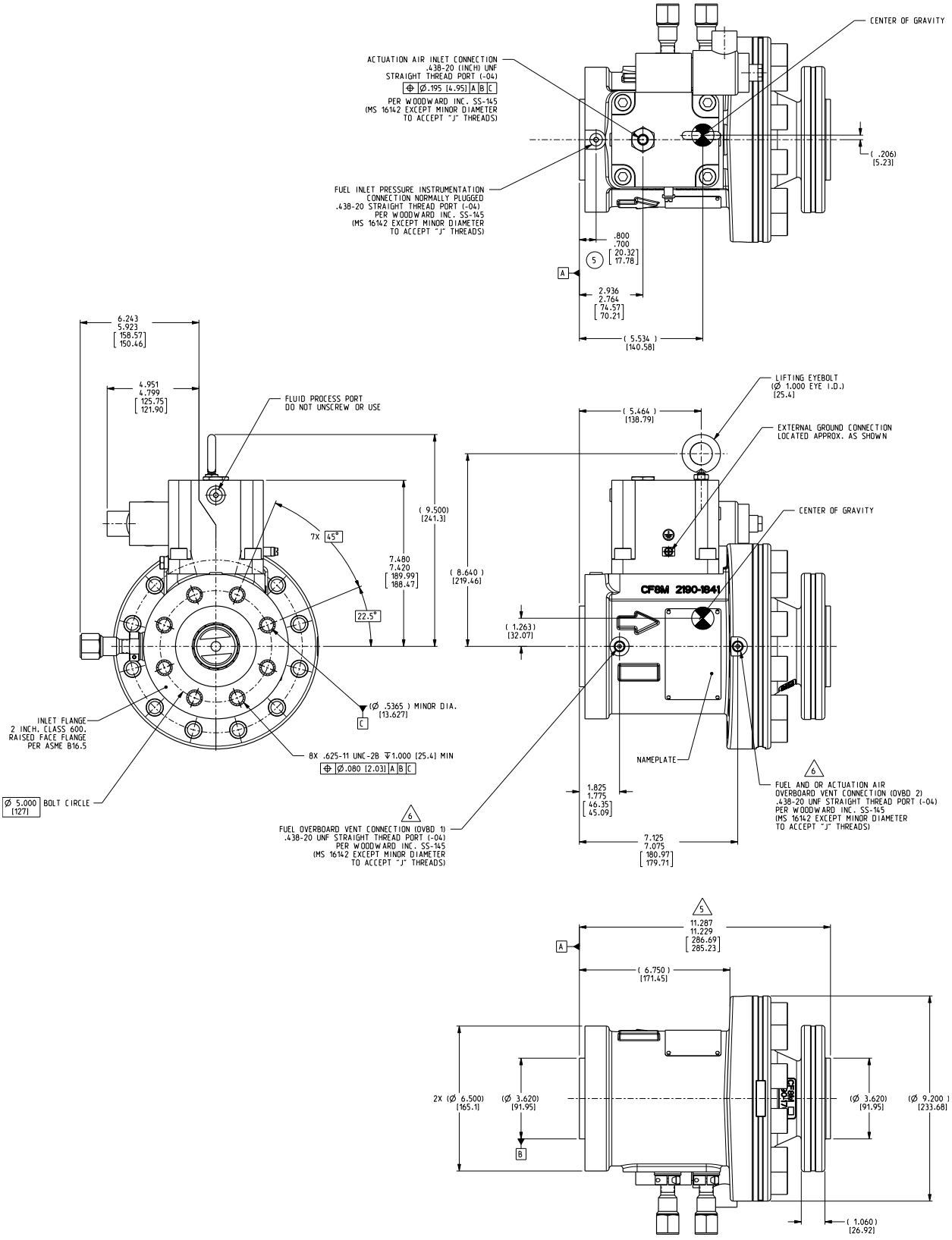
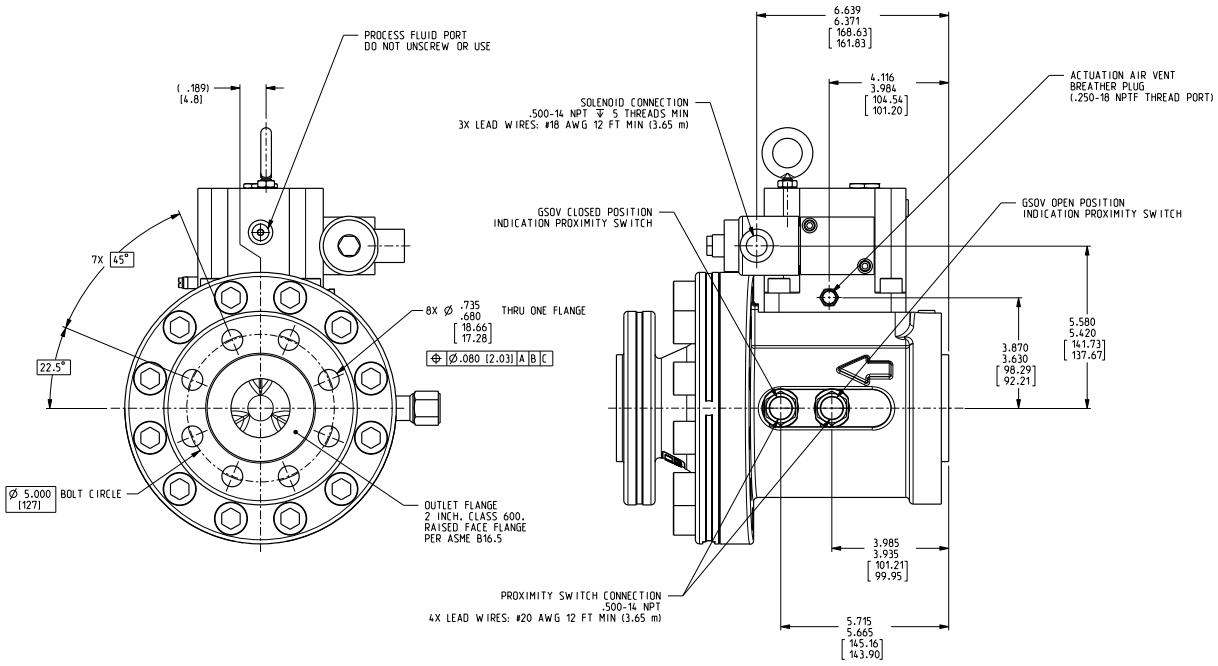


Figure 2-2. GSOV50 H2 Version Outline Drawing (Side A)



NOTES:

1. THIS IS AN INSTALLATION DRAWING OF GSOV50 H2 (GAS SHUTOFF VALVE) WITH FLYING LEADS.
2. APPROXIMATE WEIGHT IS 108.8 LBS (49.4 kg).
3. FOR FIRST ARTICLE INSPECTION (FAI) REQUIREMENTS SEE 3-06-0005.
4. APPEARANCE MAY VARY FROM THAT SHOWN, AND MAY NOT REFLECT CURRENT HARDWARE.
5. FLANGE FACE-TO-FACE DIMENSION PER ISA 75.03.
6. DO NOT PLUG OR RESTRICT TO GREATER THAN 50 PSIG (345 kPa). PLUMB OVERBOARD VENTS TO NON-HAZARDOUS AREA.

OPTION CHART	
PART NUMBER	SOLENOID VOLTAGE
9907-2468	24 VDC
9907-2469	125 VDC

Figure 2-3. GSOV50 H2 Version Outline Drawing (Side B)

Electrical Connections

⚠WARNING

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

NOTICE

Support conduit fittings while making conduit connections.

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.

NOTICE

For devices that list more than one method of protection, it is the installer's responsibility to permanently mark all applicable nameplates to show which method of protection is used in the installation of that device (per IEC/EN 60079-0).

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 2-2 ,2-4 and 2-5).

⚠WARNING

The valve must be connected to suitable ground through the external grounding terminal. See Figures 2-2, 2-4 and 2-5.

Customer wiring to the solenoid valve and proximity switch is provided via flying leads.
Solenoid Valve Flying Leads: 3x #18 WG,12 feet (3.65 meter) long.
Proximity Switch Flying Leads: 4x #18 WG,12 feet (3.65 meter) long.

All input power supply wires must comply with local code requirements and be of sufficient size that the power supply voltage minus the IR loss in the two lead wires does not drop below voltage requirements.

Solenoid Valve

The solenoid valve requires an input voltage between 18 and 32 Vdc for 24 Vdc model, or between 90 and 140 Vdc for 125 Vdc model. Review the specification table for expected power consumption when selecting a power supply.

A 0.5-14 NPT threaded port is provided for the electrical connection. Connect the two wires extending from the conduit connector to the proper supply voltage as shown in Figure 2-4 below; polarity is not important.

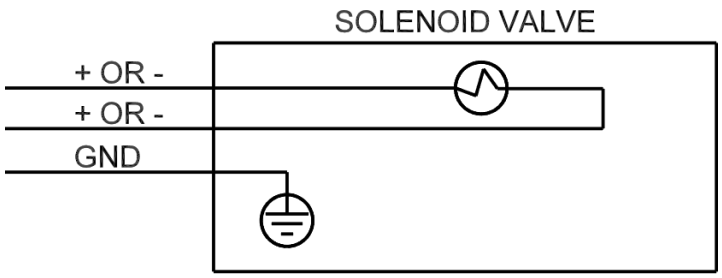


Figure 2-4. Solenoid Wiring Diagram

IMPORTANT

To rotate or re-position the solenoid coil conduit housing: Remove the thin cap nut and loosen the large circular nut by turning it counterclockwise. Rotate the conduit housing to the desired position and tighten the circular nut by hand only. Do not use a tool on the circular nut, which could cause over-tightening. Re-install the thin cap nut and torque to 12–15 lb-ft (16–20 N•m).

IMPORTANT

The solenoid valve is not supplied with an input power disconnect device, or overcurrent protection means (fuse). These must be provided by the final installation in accordance with local codes and the authority having jurisdiction.

Proximity Switch

This valve design incorporates two proximity switches. The proximity switches are intended to indicate when the valve is fully closed or fully open. Any intermediate position will be indicated as the valve being open.

The proximity switch is a single-pole, double-throw (SPDT) type with Form C contacts. The contacts are rated for 0.5 A at 125 VDC. Four color-coded leads extend from the switch housing: red is the normally closed contact, blue is the normally open contact, black is the common, and green is the case ground. The switch may be wired to use either one or both contacts.

See the Maintenance section below for additional information on the proximity switch.

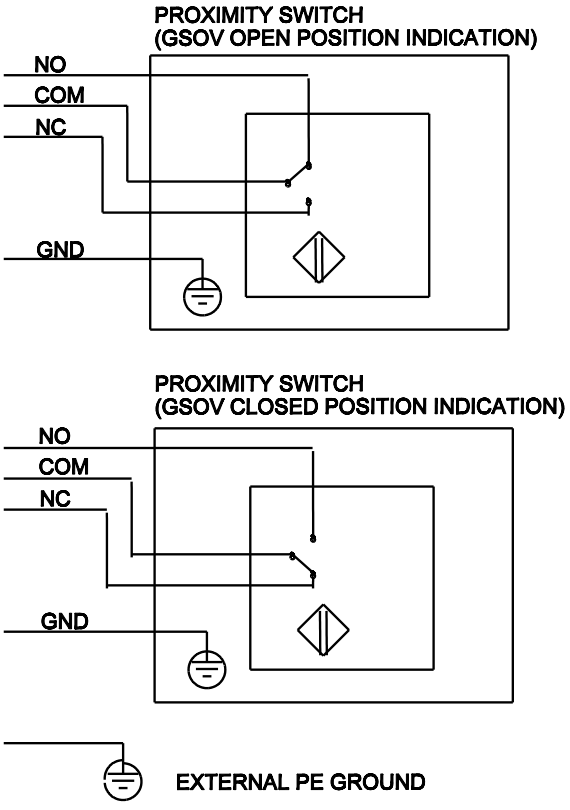


Figure 2-5. Proximity Switches Wiring Diagram

WARNING

The switch must be held in the factory installed position to ensure that it is not inadvertently moved during conduit nut tightening to maintain the proper gap between the proximity switch and the piston.

An absence of a gap between the proximity switch and the piston can cause the valve to malfunction or become inoperable. Carefully review Figure 2-6. Use a wrench to maintain the rotational orientation of the proximity switch during field conduit installation.

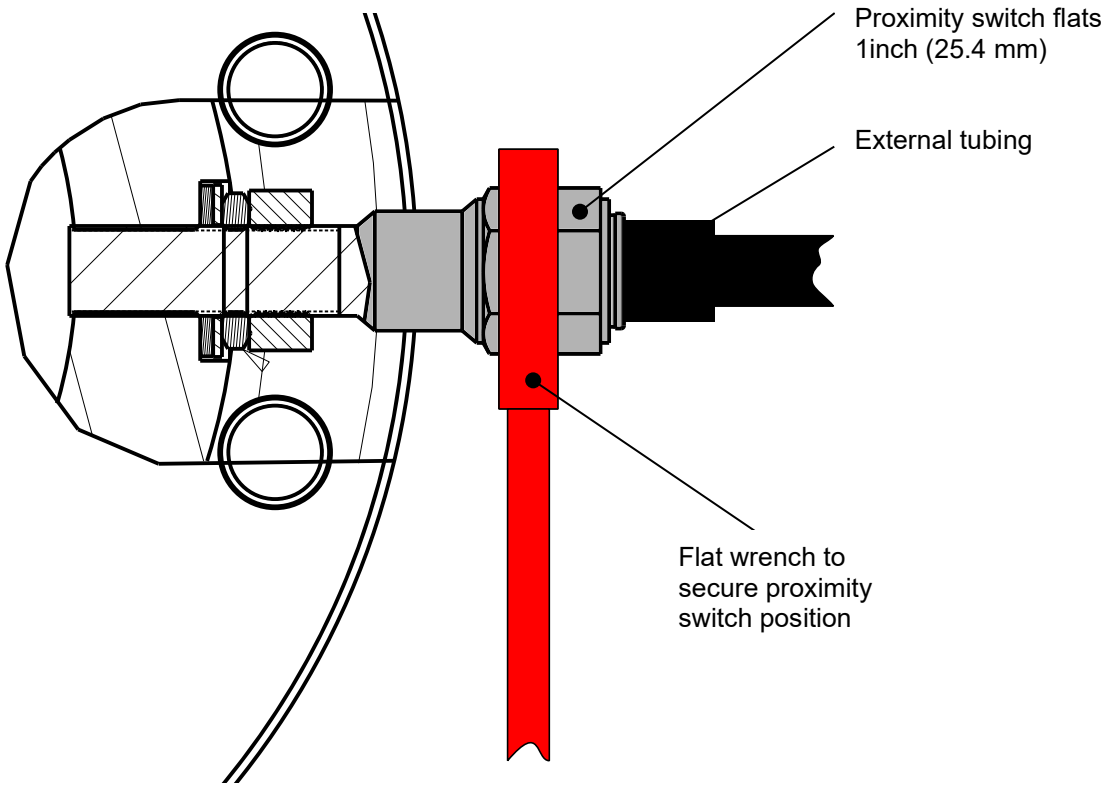


Figure 2-6. GSOV50 H2 - Securing The Proximity Switch Position with a Flat Wrench

Maintenance

WARNING

Review all warnings and safety information in the Installation section prior to performing any maintenance or service. Failure to do so could result in serious injury or death.

WARNING

Before doing any maintenance on the GSOV50 H2, inlet and outlet gas pressure must be relieved. Failure to remove gas pressure from the inlet and discharge of the valve may result in equipment damage, personal injury, or death.

WARNING

To prevent possible serious personal injury, or damage to equipment, be sure all electric power and gas pressure have been removed from the valve and actuator before beginning any maintenance.

⚠CAUTION **Pressurized air discharge from the vent breather located on the GSOV50 H2 may injure skin that is in close contact during a closing event. Keep clear of the vent when cycling the valve.**

Electrical power should be removed from the GSOV50 H2 whenever working on or near the solenoid or proximity switch.

Because of the critical function of the GSOV50 H2, it is mandatory that turbine operators regularly monitor the condition of the valve. It should be inspected during all turbine maintenance intervals.

To verify proper operation during shutdown conditions:

- Ensure that the solenoid operator is de-energized.
- Verify that actuation air supply pressure between 5.52 bar (80 psig) and 9.65 bar (140 psig) is present at the actuation air supply port at standard conditions.
  During opening occurrence, a minimum of 13.8 m³/h (8.1 ft³/min) air supply flow rate is required to properly open the GSOV50 H2 in specified time.
- Check for leakage from the valve seals by measuring the leakage flow rate from the fuel overboard vent connections. Leakage in excess of 15.2 in^3 (250 cm³)/min may indicate valve seal wear or a possible malfunction.
- At very low ambient temperatures, the overboard vent leakage may be higher.

If properly maintained and operated within its design limits, the GSOV50 will operate up to 50 000 hours or 20 000 cycles before requiring repair or overhaul. The following maintenance checks should be completed at the prescribed intervals.

Electrical power should be removed from the GSOV50 H2 whenever working on or near the solenoid or proximity switch

Actuation Air Filter

To ensure optimum performance of the valve, the pilot-section filter should be removed and cleaned at least once per year, or more often if system contamination levels are higher than normal. See Figure 2-2 and 2-3 for the location of the pilot filter. Remove the pilot filter by turning counterclockwise on the 1.000 inch (25.40 mm) hex head nut. The filter may be cleaned ultrasonically or back-flushed with light solvent. Inspect the O-ring seals and replace as necessary. Lightly lubricate the O-rings with high temperature lubricant (Uniflor 8921 or equivalent) and torque pilot filter nut to 195 - 205 LBIN (22 – 23.2 Nm) after re-assembly.

Solenoid Valve

There is no regular maintenance required on the solenoid valve, but the following information can be used to troubleshoot problems related to the solenoid valve.

Review the specification section for solenoid voltage requirements and expected resistance.

Routinely check the shutdown switches or relays to be sure they are capable of terminating the electrical supply to the solenoid. The fuel isolation valve should be used whenever possible to be sure it is operating satisfactorily.

Proximity Switch

There is no regular maintenance required on the proximity switch, but the following information can be used to troubleshoot problems related to the proximity switch.

The switch contains a Form C contact with four leads extending from the switch. Red is the normally-closed contact, blue is the normally-open contact, black is common, and green is the case ground.

Valve has a proximity switch in the CLOSED position, following values apply:
1. When the valve is closed, the dc resistance across the contacts should read:
   Normally closed (NC): open circuit
   Normally open (NO): 0.1–1.0 Ω
2. When the valve is open, the dc resistance across the contacts should read:
   Normally closed (NC): 0.1–1.0 Ω
   Normally open (NO): open circuit

Valve has a proximity switch in the OPEN position, following values apply:
3. When the valve is open, the dc resistance across the contacts should read:
   Normally closed (NC): open circuit
   Normally open (NO): 0.1–1.0 Ω
4. When the valve is closed, the dc resistance across the contacts should read:
   Normally closed (NC): 0.1–1.0 Ω
   Normally open (NO): open circuit

If an erroneous or intermittent switch indication is observed, check the continuity of each switch contact as described above. Lightly tap the proximity switch with a wrench or small hammer. The proximity switch should not be affected by these small mechanical disturbances. If the contacts change state with a light tap or do not read the correct dc resistance as given above may indicate switch wear or a possible malfunction.

Main Seat Leakage

The valve is designed to maintain main seat leakage at the level of ANSI/FCI 70-2 Class VI prorated up to max. pressure according to tables below:

Table 2-2. Main Seat Forward Leakage (Class VI)

Fuel Pressure [psig]	Leakage [cm^3/min]
50	0.45
600	5.40
900	8.10

Table 2-3. Main Seat Reverse Leakage (Class VI)

Fuel Pressure [psig]	Leakage [cm^3/min]
50	0.45
500	4.50

Main seat leakage performance will degrade towards ANSI/FCI 70-2 Class V, which is defined as the recommended overhaul limit for the GSOV50 H2. The limits of Class V are shown in tables below:

Table 2-4. Main Seat Forward Leakage (Class V)

Fuel Pressure [psig]	Leakage [cm^3/min]
50	9.40
600	112.80
900	169.20

Table 2-5. Main Seat Reverse Leakage (Class V)

Fuel Pressure [psig]	Leakage [cm^3/min]
50	9.40
500	94.00

This leakage level shall be an indicator of necessary valve overhaul.

Gas / Actuation Air Overboard Vent Leakage

Diligent monitoring of the 2X overboard vent connections can provide early warning of seal degradation or internal contamination of the valve, which may result in unreliable valve operation. Should the overboard vent leakage from either port exceed 100 sccm, over the pressure range of 50 psig (3.44 bar), up to the flange rated pressure, and when measured at room temperature, an overhaul of the valve is advised.

External Pilot Pressure Operation

The fuel isolation valve GSOV50 H2 is actuated open by the Pilot Supply connection.

The minimum required pilot air pressure to open the valve is 80 psig (5.52 bar).

IMPORTANT

A Pilot Air Supply pressure of 80 psig (5.52 bar) will ensure proper valve actuation for all inlet gas supply pressures up to the maximum valve rating of 900 psig (62.05 bar).

⚠WARNING

The actuation medium shall be air or nitrogen. Do not use fuel to actuate the valve, as this may result in hazardous valve damage.

Chapter 3.
Principles of Operation

Introduction

Figures 3-1 and 3-2 illustrate the operating principle of the GSOV50 H2 gas fuel isolation valve.

Valve Open

To open the valve, follow the steps below:
1. Energize the solenoid with the appropriate voltage.
2. The three-way solenoid connects actuation air pressure to the control land of the second stage piston.
3. At actuation air pressures in the acceptable range, the second stage piston is driven to the end of its bore, opening the actuation air pressure to the control land of the primary stage piston, while simultaneously sealing the passage from the vent connection.
4. The actuation air pressure on the primary stage piston control land overcomes the spring force of the return spring and drives the piston to the end of its bore, separating the piston from the primary seal.

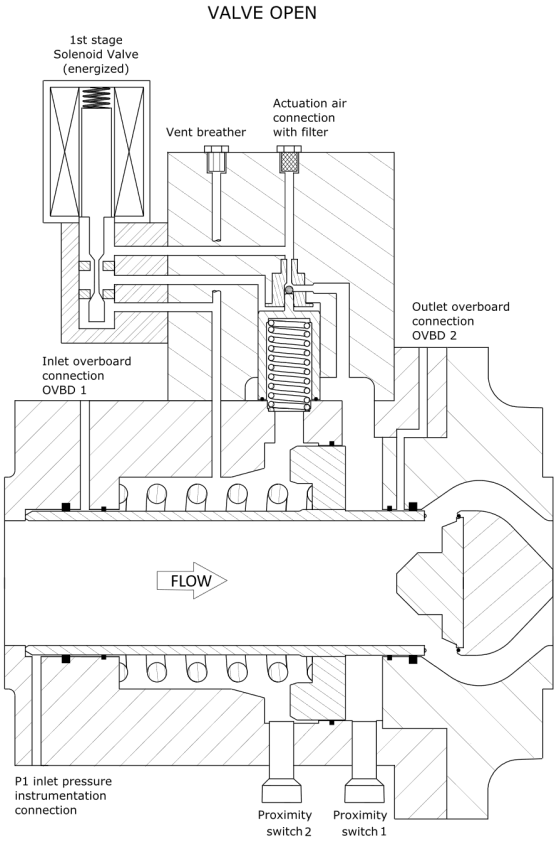


Figure 3-1. Energized—Valve Open

Valve Closed

To close the valve, follow the steps below:

1. De-energize the solenoid.
2. The three-way solenoid connects the pressure on the control land of the second stage piston to the vent.
3. The spring under the second stage piston overcomes the pressure on the control land and drives the second stage piston to the opposite end of its bore, seating the second stage ball seat and sealing the actuation air pressure from the primary stage piston control land.
4. As the second stage piston moves to the opposite end of its bore, the piston separates from the second stage piston seal and allows the pressure on the primary stage control land to vent.
5. The primary stage return spring overcomes the pressure on the control land and drives the primary stage piston against the primary stage piston seal.

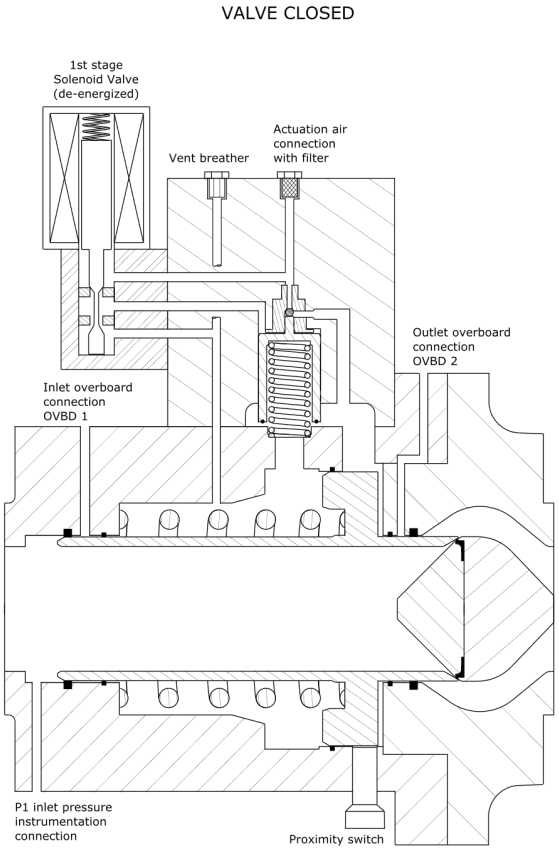


Figure 3-2. De-energized—Valve Closed

A 40 µm last chance filter screen protects the actuation stage of the valve and the solenoid control valve from damage due to particulate contamination. No screen or filter is provided for the fuel flowing to the turbine. The valve is either fully open or closed, sealed tightly off.

Failsafe Principle

The GSOV50 H2 operates with three stages of valving. This design is necessary to ensure the high speed fuel isolation and maintain the low pressure drop/high flow rate valve. Each of the three stages is spring loaded with the force needed to ensure valve closure.

The first stage solenoid valve is a poppet-style solenoid, spring loaded with an Inconel spring to the closed position, requiring a voltage supply to allow pilot pressure to the second stage piston control land.

The second stage piston assembly has a dual function for the valve. In the normally-closed position, the piston is spring loaded to seal pilot pressure from the primary stage by seating a stainless steel ball, while simultaneously opening a large vent that allows any pressure from the primary stage to vent through an external breather vent. Actuation air pressure greater than 5.52 bar (80 psig) is required at the second stage control land to overcome the spring force and move the piston to the opposite end of its bore. In this position the vent connection is sealed by an encapsulated O-ring/face seal while simultaneously allowing actuation air pressure to fill the primary stage control land.

The primary stage piston is spring loaded to the closed position and seated against a face seal. Actuation air pressure greater than 5.52 bar (80 psig) is required at the control land of the third stage piston to overcome the spring force and allow the piston to move to the open position.

Table 3-1. Failure Modes

Failure	Result
Loss of Pilot Pressure	When actuation air pressure is less than 4.14 bar (60 psig), the spring force of the second stage piston overcomes the area/pressure of the control land, moving the piston to seal the pressure from the third stage piston, and opens the vent connection which allows any trapped pressure at the third stage control land to vent through the breather vent. The spring loaded third stage piston will move to the closed position within the 100 ms time specification.
Loss of Voltage to Solenoid	As the voltage is removed from the solenoid, the spring-loaded poppet valve in the solenoid closes the pressure to the second stage while opening a vent to allow any trapped pressure in this area to vent to the breather vent. When the spring loading of the second stage piston overcomes the area/pressure of the control land, the piston moves to seal the pressure from the third stage piston and opens the vent connection which allows any trapped pressure at the third stage control land to vent through the breather vent. The spring-loaded third stage piston will move to the closed position within the 100 ms time specification.

Determination of Effective Area (ACd)

To confirm that the sizes of the GSOV valves are appropriate for the application, the effective area required to meet the maximum flow requirement must first be determined. The flow rate attainable under a given set of process fluid conditions are constrained by the values of inlet pressure, inlet temperature, discharge pressure, and gas properties. Using these values, the flow rate can be determined for any given value of the valve capacity coefficient (ACd) using the following equation.

$$Wf = 3955.289 \cdot ACd \cdot P1 \cdot \sqrt{\left[\frac{K \cdot SG}{(K-1) \cdot T \cdot Z}\right] \cdot \left[\left(\frac{P2}{P1}\right)^{\frac{2}{K}} - \left(\frac{P2}{P1}\right)^{\frac{1+K}{K}}\right]}$$

Wf = Mass Flow Rate (pph)

ACd = Effective Area (square inches), GSOV50 H2 ACd (gas) = 2.4 in² (1548 mm²)

R7 = Critical Pressure Ratio

P1 = Valve Inlet Pressure (psia)

P2 = Valve Discharge Pressure (psia)

K = Ratio of Specific Heats:

Gas Type	Ratio of Specific Heats at 60 °F
Standard Natural Gas	1.300
Hydrogen	1.405

SG = Specific Gravity relative to air (0.60 typical for standard natural gas)

T = Absolute Gas Temperature (degrees Rankine) (Deg R = Deg F + 459.7)

Z = Gas Compressibility Factor (see note)

IMPORTANT

Notes

It is recommended that the effective area for the chosen port be at least 10% larger than the highest required mass flow using the equations shown in order to have margin.

The valve size selected should be adequate (with at least 10% margin) for worst-case flow conditions. This would be minimum P1, maximum P2, maximum flow, and at the maximum expected fuel temperature.

For general sizing purposes, a value for Z (Gas Compressibility Factor) of 1.0 can be used since its effect on the result is relatively small.

Flow Characteristics of the GSOV50 H2

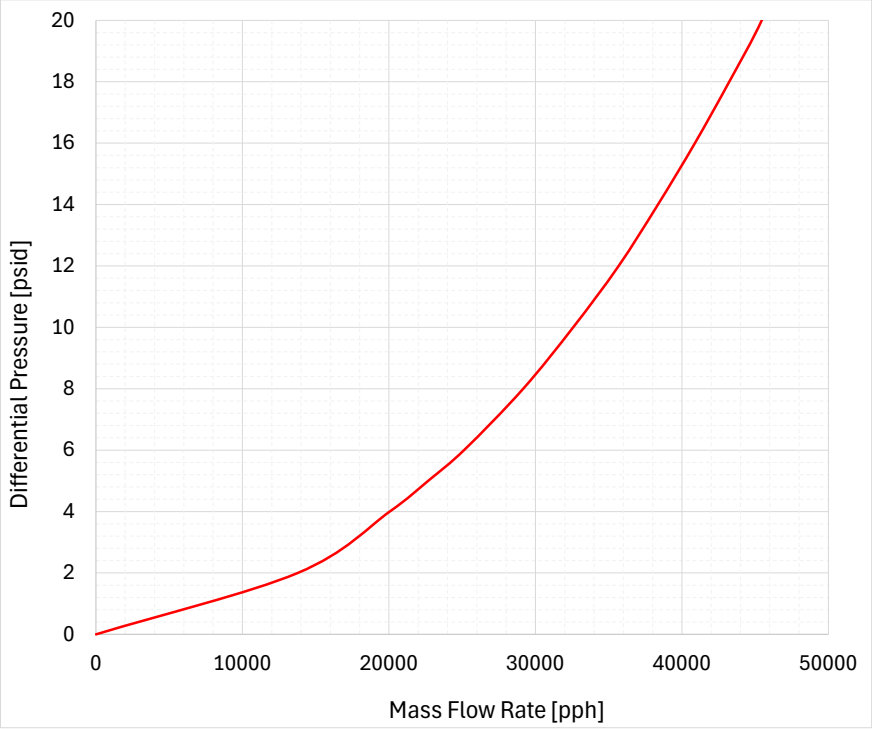


Figure 3-3. GSOV50 H2 Delta P vs Flow (Based on test performed with Air Flow at P1 600 psig, 518 deg R)(The Valve Effective Area is 2.4 in^2 1548 mm^2)

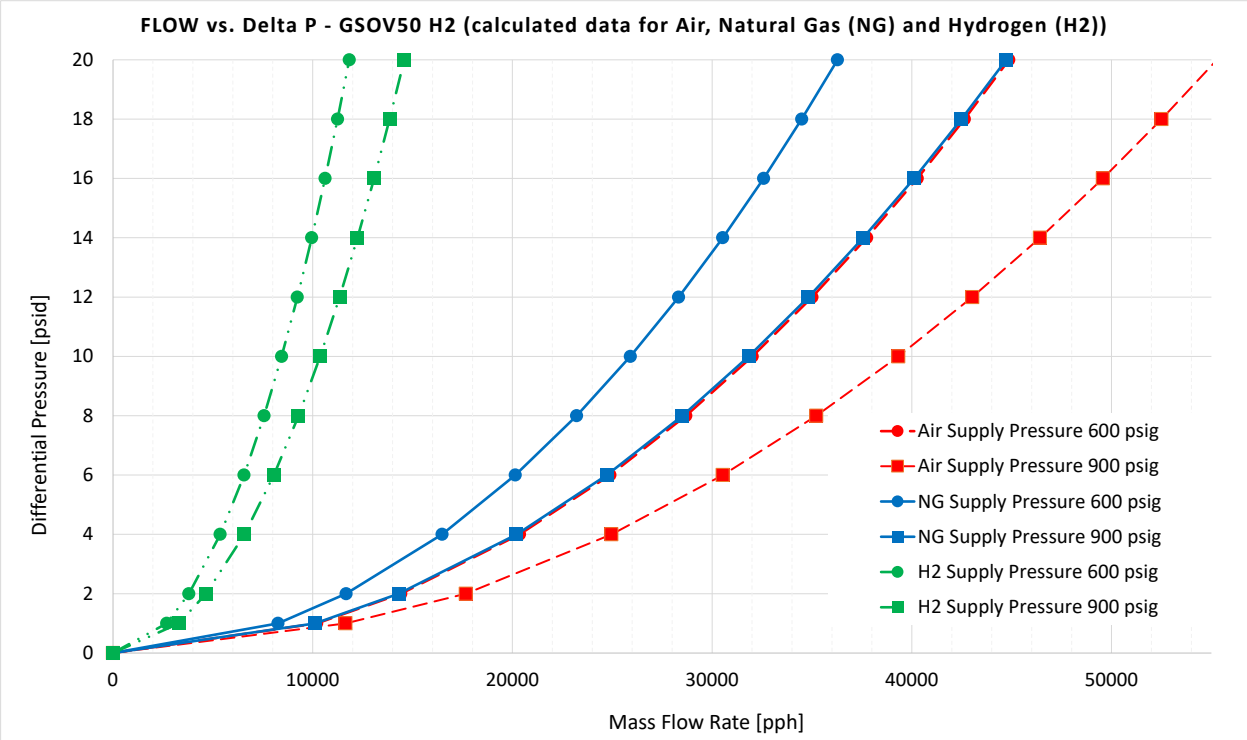


Figure 3-4. GSOV50 H2 Flow vs. Delta P (Calculated Data for Natural Gas and Hydrogen at 518 deg R)

Chapter 4.
Safety Management

Response Time Data

The GSOV50 H2 full stroke response time to close is as follows:

- Maximum 100 ms @ 900 psig (62.05 bar) inlet pressure

Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the useful life of the GSOV50 H2 is 20,000 cycles.

Restrictions

The user must complete a full functional check of the GSOV50 H2 after initial installation, and after any modification of the overall safety system. No modification shall be made to the GSOV50 H2 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 GSOV50 H2 must be used within the published specification in this manual.

Competence of Personnel

All personnel involved in the installation and maintenance of the GSOV50 H2 must have appropriate training.

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

Operation and Maintenance Practice

A periodic proof (functional) test of the GSOV50 H2 is required to verify proper operation. More information is in the “Proof Test” section below. The frequency of the proof test is determined by the overall safety system design, of which the GSOV50 H2 is part of the safety system. The safety numbers are given in the following sections to help the system integrator determine the appropriate test interval.

The GSOV50 H2 requires no special tools for operation or maintenance.

Installation and Site Acceptance Testing

Installation and use of the GSOV50 H2 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 GSOV50 H2 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 Proof Test procedure below.

Functional Testing after Changes

A functional test of the GSOV50 H2 is required after making any changes that affect the safety system. Although there are functions in the GSOV50 H2 that are not directly safety related, it is recommended that a functional test be performed after any change.

Proof Test (Functional Test)

The GSOV50 H2 must be periodically proof tested to reveal dangerous faults which are undetected by automatic diagnostic tests. This proof test should be performed at least once per 18 months during shutdown conditions and should consist of a full stroke of the actuator and valve per the following:

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Interrupt or change the air supply to the actuator to force the actuator/valve assembly to the Fail-Safe state and confirm that the Safe State was achieved and within the correct time.
3. Re-store the air supply to the Actuator, inspect the Actuator and Valve for any leaks, visible damage, or contamination, and confirm that the normal operating state was achieved.
4. Remove the bypass and otherwise restore normal operation.

For the test to be effective, the movement of the valve must be confirmed. To confirm the effectiveness of the test of both the travel of the valve and slew rate must be monitored and compared to expected results to validate the testing.

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:
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
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
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.

Chapter 6.
Long-Term Storage Requirements

Units that will not be put into service within twelve months should be packaged for long-term storage as described in Woodward manual 25075, Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls.

Recommended long term storage temperature for longest life: +25°C +/- 10°C.

Revision History

Changes in Revision 50 —

- Initial release

Declarations

EU Declaration of Conformity No:	00687-EU-ATEX-02-01
EU Declaration of Incorporation No:	00687-EU-MD-02-01

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We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication 35229

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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.