WOODWARD

Product Manual 26307
(Revision P, 8/2020)
Original Instructions

Universal Shutoff Valve (USOV)

2-Inch, Liquid Only
9907-869 or Similar

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 Out-of-date translations are marked with ⚠.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 26307

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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

European Compliance for CE Marking:

Pressure Equipment Directive

Directive 2014/68/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment.
PED Category II
PED Module H – Full Quality Assurance,
CE-0041-PED-H-WDI 001-16-USA, Bureau Veritas UK Ltd (0041)

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
Assembly is suitable for Zone 2, Category 3, Group II G, T3. This suitability is the result of ATEX compliance of the individual components as follows:

Solenoid Valve per SIRA 11ATEX4210X Zone 2, Category 3, Group II G, Ex nA IIC T3 Gc, IP66 (installed for Zone 2 only)

Proximity Switch per Baseefa 08ATEX0360X Zone 1, Category 2, Group II G, Ex d IIC T3 Gb

Junction Box assembly suitable for Zone 2, Category 3, Group II G, Ex nA T5 Gc, IP66 (self-declared)

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

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.

ATEX:

Exempt from the ATEX Directive 2014/34/EU as non-electrical equipment bearing no potential ignition sources per EN 13463-1. Suitable for Zone 2, Category 3 IIC T3.

North American Compliance:

CSA:

CSA Certified for Class I, Division 2, Groups A, B, C, and D, T3 at 82 °C Ambient. For use in Canada and the United States.
Certificate 160584-1125151

SIL Certification

USOV – Universal Shutoff Valve – Certified SIL 3 Capable for Shutoff in safety instrumented systems. Evaluated to IEC 61508 Parts 1-7. Refer to the instructions of this Installation and Operation Manual, Chapter 4 Safety Management.
SIL Certificate WOO 1503125 C001

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

⚠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 et/ou Zone 2.

Chapter 1.
General Description

Introduction

⚠WARNING

The fuel isolation valve is a critical component for protection against equipment failure or turbine overspeed. Routine inspection is necessary for the protection of the turbine.

The Universal Shutoff Valve (USOV) is a high-speed fuel shutoff valve designed to terminate the turbine liquid fuel or water supply should the electronic fuel control or sequencer interrupt the permissive electrical signal.

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.
- Verify that actuation air supply pressure between 80 psig (552 kPa) and 140 psig (965 kPa) with a minimum of 6.28 CFM (10.66 m^3/h) flow rate is present at the actuation air supply port.
- Check for leakage through the valve seals by measuring the leakage flow rate from the fuel overboard vent connections. Leakage in excess of 5 cm^3/min may indicate valve seal wear or a possible malfunction.

IMPORTANT

Actuation air pressure of 80 psig (552 kPa) to 140 psig (965 kPa) and a minimum flow rate of 6.28 CFM (10.66 m^3/h) will assure proper valve actuation for all liquid supply pressures up to the maximum valve rating.

Universal Shutoff Valve Description

The USOV is a normally-closed, three-stage device, designed to terminate liquid fuel flow in less than 100 ms at 1800 psig (12 411 kPa)., after interruption of the electrical supply current. Valve closure is due to the stored energy of a coiled spring in the primary stage.

The valve is compatible with de-ionized water and most liquid fuels, including diesel fuel, methanol, ethanol, Jet "A", kerosene, #2 home heating oil, heated light crudes, and residuals. All-stainless-steel components with Viton and PTFE seal materials accommodate most fuel contaminants.

An integral 40 µm (nominal) filter screen protects the first and second stage components from damage due to particulate contamination. The fuel isolation valve is constructed of corrosion-resistant materials. The 2 inch (50.8 mm) USOV weighs 216 lb (98 kg) The valve will positively seal in a reverse-pressure condition up to 650 psig (4482 kPa).

The valve is designed to be NACE compliant per NACE MR0175-2000 sulfide stress cracking resistant metallic materials for oilfield equipment, NACE International.

Table 1-1. Specifications

Closing Time	Less than 100 ms at all conditions
Opening Time	Less than 1 s at all conditions
Cycle Life	2500 cycles
Minimum Allowed Actuation Pressure	80 psig (552 kPa)
Maximum Allowed Actuation Pressure	140 psig (965 kPa)
Maximum Allowed Operating Pressure	1800 psig (12 411 kPa) from –40 to +150 °F (–40 to +66 °C) 1600 psig (11 032 kPa) from 151 to 250 °F (66 to 121 °C)
Valve Proof Pressure	2700 psig (18 616 kPa)
Valve Burst Pressure	10 800 psig (74 466 kPa)
Maximum Allowed Vent Port Back Pressure	50 psig (345 kPa)
Maximum Allowed Reverse Pressure	650 psig (4482 kPa)
Valve Leakage Rating	For new and refurbished valves: ANSI/FCI 70-2-1991 Class VI, forward and reverse and MSS SP-61. In the reverse direction, Class VI leakage is limited to 4482 kPa (650 psig).
Maximum Allowed Liquid Fuel/Actuation Air Overboard Vent Leakage	5 cm^3/min steady state at max operating pressure conditions
Internal Filtration for Solenoid	40 µm
Max Allowed Solid Particle Contaminants in Fuel	Less than or equal to 10 µm, 30 ppm by volume maximum Greater than 10 µm, 0.3 ppm by volume maximum
Valve Weight (2”)	216 lb (98 kg)
Fuel Compatibility	De-ionized water, diesel fuel, methanol, ethanol, Jet "A", kerosene, #2 home heating oil, heated light crudes, residuals or most typical liquid fuels
Ambient Temperature Range	–40 to +180 °F (–40 to +82 °C)
Fuel Temperature Range (2”)	–40 to +250 °F (–40 to +121 °C)
Nominal Pipe/Flange Size	2” (50.8 mm) Class 900, raised face per ASME B16.5 except with 8X 0.875-9 tapped holes
Proximity Switch Contact Ratings	0.5 A @ 24 Vdc
Solenoid Voltage	18 to 32 Vdc
Solenoid Power Consumption	10 W
Ingress Protection Rating	IP66

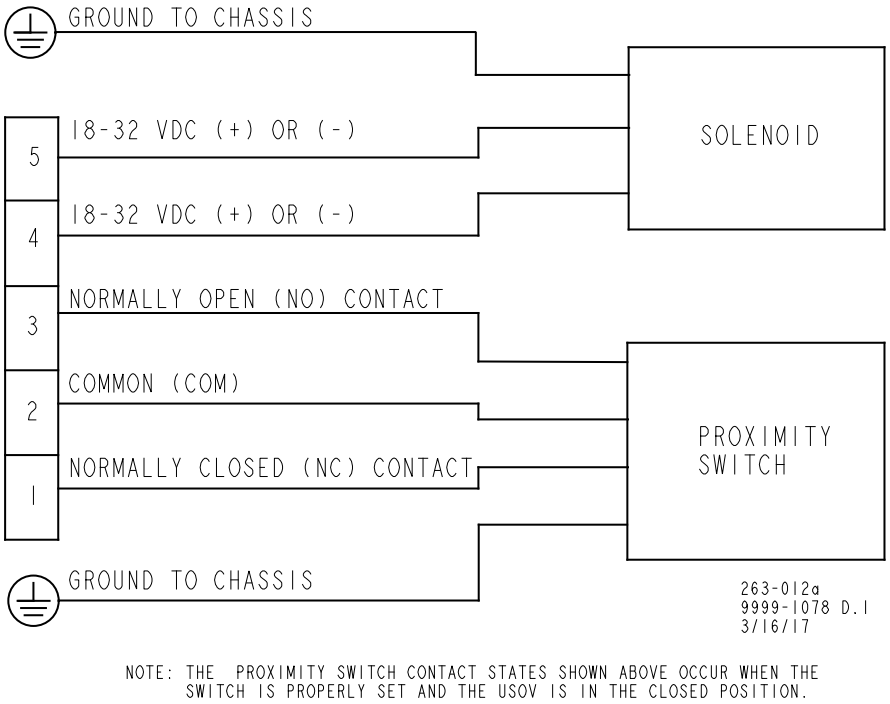


Figure 1-1. USOV Wiring Diagram

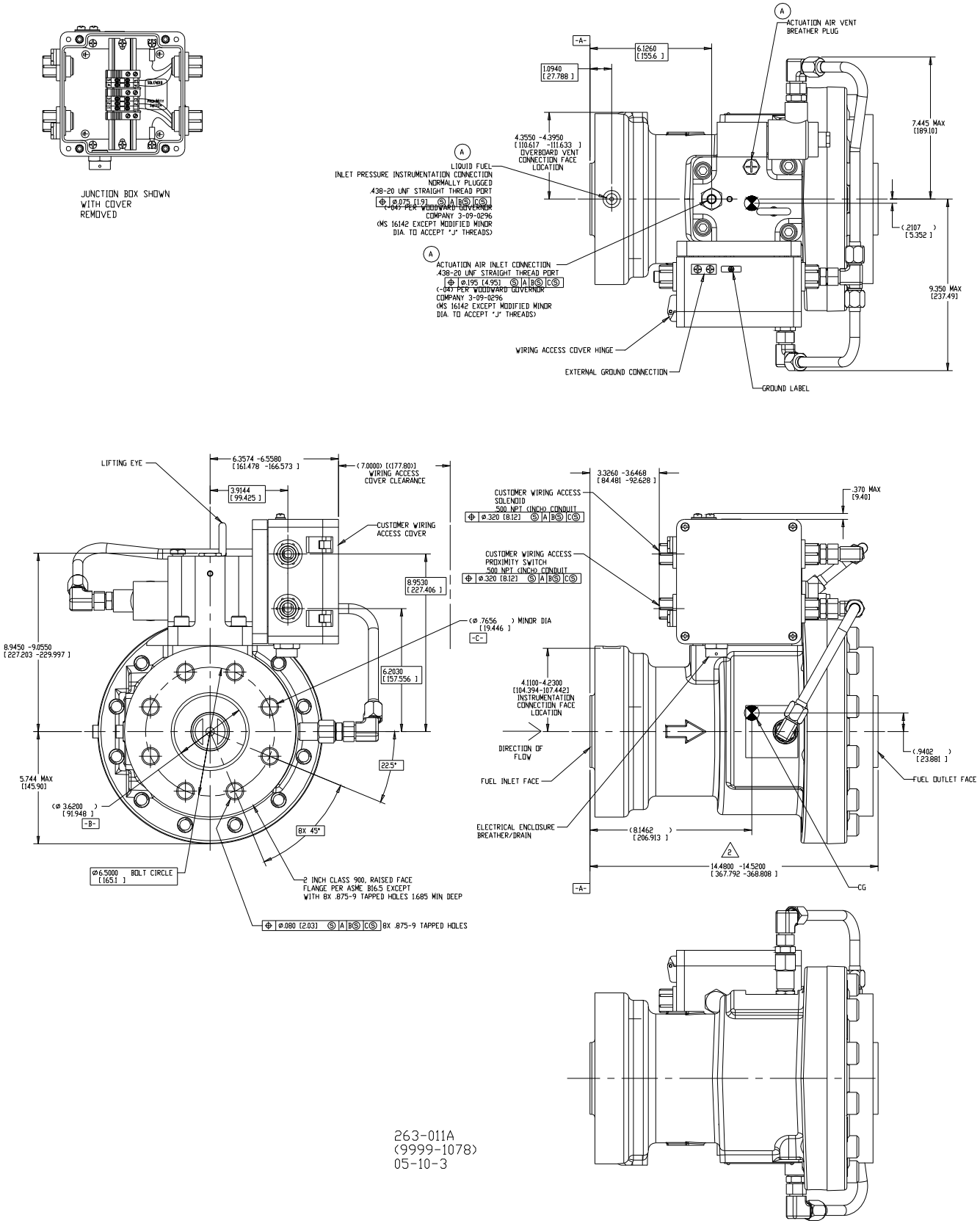


Figure 1-2a. Outline Drawing of 2 inch USOV

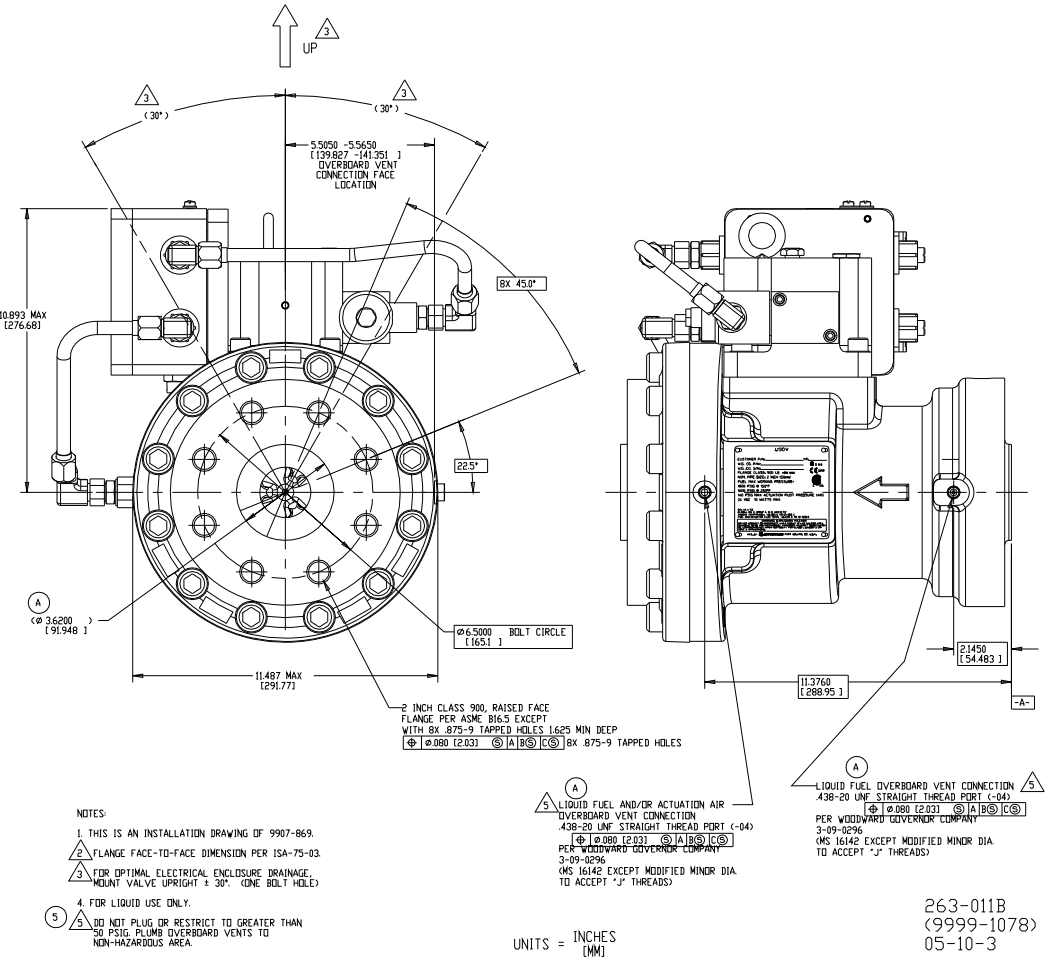


Figure 1-2b. Outline Drawing of 2 inch USOV

Chapter 2.
Installation and Maintenance

Receiving

The USOV is tested with dry air and then packed in a foam-filled box for shipment. The unit may be stored for an extended period in the original container.

Installation

⚠WARNING

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

The surface temperature of this valve approaches the maximum temperature of the applied process media. It is the responsibility of the user to ensure that the external environment contains no hazardous gases capable of ignition in the range of the process media temperatures.

⚠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

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

⚠WARNING

Do not lift or handle the valve by any conduit or piping. Lift or handle the valve using the lifting eye provided for this purpose.

NOTICE

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.

The valve is designed for installation between two standard 2-inch (50.8 mm), 900-pound (408 kg) flanges per ANSI B16.5. The inlet and outlet flange are threaded per the outline drawings previous. The installer must supply gaskets as required to assure a leak-proof seal at both inlet and outlet flanges. Refer to ASME B16.5 for details of flange, gasket, and bolt types and dimensions. Use appropriate lifting equipment during installation.

The USOV is designed for support by the piping flanges alone; additional supports are neither needed nor recommended.

During steady-state operation (open or closed) flow from the liquid fuel/actuation air overboard vents should not exceed 5 cm^3/min. Flow in excess of this may be a sign of seal wear or malfunction. Back pressure on the overboard vent connections should not exceed 50 psig (345 kPa).

NOTICE

Do not plug or restrict flow from the liquid fuel/actuation air overboard vent ports. These vent ports should be connected to a liquid fuel drain header in a non-hazardous area.

Electrical Connections

⚠WARNING

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

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 1-1).

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).

The solenoid valve and switch are connected by conduit to a junction box. All wiring of these components is done inside the junction box. The junction box terminals are labeled to ensure correct wiring. Refer also to the wiring diagram in Figure 1-1.

Solenoid Valve

Connect the two junction box terminals to the proper supply voltage, 18–32 Vdc, according to Figure 1-1. Polarity is not important. Power consumption for all models is 10 W.

See the Maintenance section below for more information on the solenoid valve.

Proximity Switch

The proximity switch is designed to inform the operator when the valve is fully closed. Any intermediate positions will be indicated as valve open. The proximity switch is a single-pole, dual-throw (SPDT) type with Form C contacts. The contacts are rated for 0.5 A at 24 Vdc. Connect the junction box terminals to the proper supply voltage according to Figure 1-1.

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

Maintenance

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

⚠WARNING

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

Electrical power should be removed from the USOV 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 1-2 (outline drawing) 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. The replacement O-rings are available from Woodward by request. Lightly lubricate the O-rings with petroleum jelly and torque pilot filter nut to 200 lb-in (23 N·m) after re-assembly.

Liquid Fuel/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.

NOTICE

Do not plug or restrict flow from the liquid fuel/actuation air overboard vent ports.

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.

The typical dc resistance of the 24 Vdc coil is 56 Ω. Nominal current draw of the 24 Vdc coil is 400 mA. System voltage must be less than 0.5 Vdc for solenoid dropout with 80 psig (552 kPa) actuation air supply.

The solenoid valve can be replaced in the field if necessary. Disconnect solenoid wires from terminals in the junction box. Remove conduit tube containing solenoid wires. Remove the solenoid from the USOV by unscrewing the two 0.250-28 Allen head screws that hold the solenoid to the valve housing. Replace the three O-ring seals if necessary (available from Woodward by request). The poppet section of the solenoid can be disassembled further and cleaned if necessary but this action is beyond the scope of this manual. If further disassembly is undertaken, take extreme care to insure proper re-assembly. Lightly lubricate the O-rings with petroleum jelly and torque the solenoid mounting screws to 81 lb-in (9.2 N·m) after re-assembly.

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.

- When the valve is closed, the dc resistance across the contacts should read:
  Across terminal blocks 2 and 3: open circuit
  Across terminal blocks 1 and 2: 0.1–1.0 Ω

- When the valve is open, the dc resistance across the contacts should read:
  Across terminal blocks 2 and 3: 0.1–1.0 Ω
  Across terminal blocks 1 and 2: 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, replace the switch.

The proximity switch can be replaced in the field if necessary. The valve must be in the closed position and have all pressure isolated from the valve to replace the switch.

1. Disconnect any wiring from terminal block in junction box and remove conduit attached to the proximity switch.
2. Bend down tabs on the locking tab washer away from jam nut.
3. Loosen the jam nut.
4. Use an adjustable wrench on the hex of the proximity switch head, back the switch out of the body by turning counterclockwise.
5. Remove thread seal, washer, locking tab washer and jam nut from the old switch and install them on the new switch. The thread seal is available from Woodward by request.
6. Apply a small amount of Loctite 242 (removable) to the new switch threads and thread into the valve body.
7. Thread by hand only the switch into the valve housing until it bottoms out on the main piston.
8. Mark the position of the switch relative to the body and then back the switch out 1/2 to 5/8 of a turn.
9. Torque the jam nut 15 lb-ft (20 N·m) while holding the hex head on the end of the proximity switch.
10. Bend up the tabs on the locking tab washer.
11. Re-assemble the switch wiring and conduit connections.

Chapter 3.
Principles of Operation

Valve Open

- Energize the solenoid with the appropriate voltage.
- The three-way solenoid connects actuation air pressure to the control land of the second stage piston.
- At actuation air pressures between 80 and 140 psig (552 and 965 kPa), 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.
- 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.

Valve Closed

- De-energize the solenoid.
- The three-way solenoid connects the pressure on the control land of the second stage piston to the vent.
- 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.
- 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.
- The primary stage return spring overcomes the pressure on the control land and drives the primary stage piston against the primary stage piston seal.

A 40-µm filter screen protects the pilot 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 USOV 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 80 psig (552 kPa) 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 80 psi (552 kPa) 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.

Valve Effective Area (ACd)

$$ACd = \frac{Wf}{19013.13 \cdot \sqrt{dP \cdot SG}}$$

where:

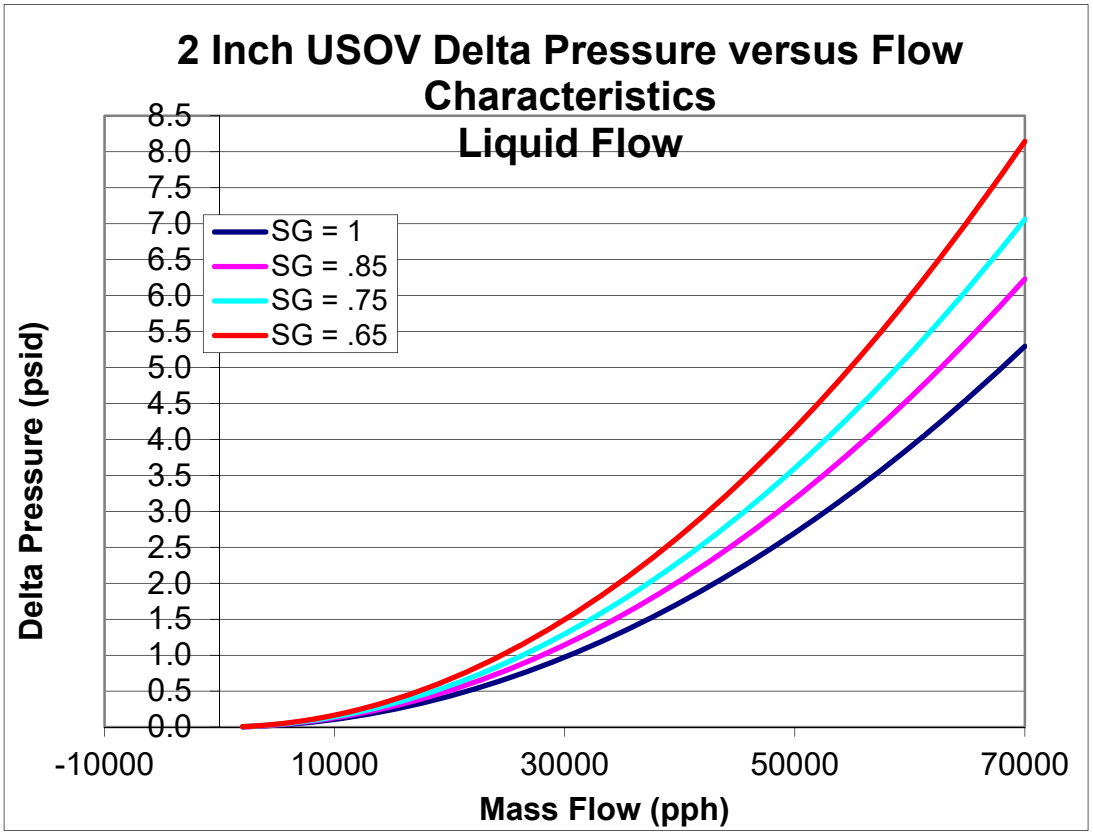
ACd = Effective Area (square inches)
Wf = Mass Flow Rate (pph [lb/h])
dP = Delta Pressure across the metering port (psid)
SG = Specific Gravity relative to water (0.82 typical for diesel fuel)

ACd = 1.6 in² (1032 mm²)

Table 3-1. Failure Modes

Failure	Result
Loss of Pilot Pressure	When actuation air pressure is less than 60 psi (414 kPa), 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.

Table 3-2. Delta P Characteristics



Chapter 4.
Safety Management

Product Variations Certified

The SIL rated 2-inch and 3-inch USOV Fuel Shutoff Valve is designed and certified to the functional safety standards according to IEC61508. Reference SIL certificate WOO 1503125 C001. Contact Woodward for a copy of the SIL certificate.

The functional safety requirement in this manual applies to all USOV Fuel Shutoff Valves. The SIL rated valves will have a DU FIT of less than 1446 for Tight Shutoff and 816 for Full Stroke versions.

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

The USOV Fuel Shutoff Valve is a high-speed fuel shutoff valve designed to terminate the turbine gas or liquid fuel supply should the electronic fuel control or sequencer interrupt the permissive electrical signal.

The following versions were considered in the FMEDA of the USOV Fuel Shutoff Valve:

USOV Fuel Shutoff Valve, Full Stroke: State where the valve is closed.

USOV Fuel Shutoff Valve, Tight Shutoff: State where the valve is closed and sealed with leakage no greater than the defined leak rate. Tight shut-off requirements shall be specified according to the application. If shut-off requirements allow flow greater than ANSI class V, ANSI class IV, then Full Stroke numbers may be used.

SFF (Safe Failure Fraction) for the USOV–Flow Sensor

The USOV 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 USOV 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 USOV , 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 15-03-125 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	713	0	1446
Full Stroke with PVST	0	713	0	816

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 USOV.

Response Time Data

The USOV full stroke response time to close is as follows:

Less than 100 ms @ 1800 psig (14 411 kPa)

Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the useful life of the USOV is 2500 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 USOV Fuel Shutoff Valve. For full functional safety certification purposes all requirements of IEC 61508 must be considered.

Restrictions

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

Competence of Personnel

All personnel involved in the installation and maintenance of the USOV must have appropriate training. Training and guidance materials are included the SIL3 USOV manual.

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

Operation and Maintenance Practice

A periodic proof (functional) test of the USOV 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 USOV 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 USOV requires no special tools for operation or maintenance.

Installation and Site Acceptance Testing

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

Proof Test (Functional Test)

The USOV 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 year 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 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 **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

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

Change in Revision P—
- Added SIL certification information to the Regulatory Compliance section
- Added Chapter 4 Safety Management

Change in Revision M—
- Updated PED and ATEX certifications in the Compliance section
- Replaced Declarations
- Replaced Fig. 1-1 with a more readable copy

Change in Revision L—
- Updated drawing on page 3
- Updated wording on page 9

Changes in Revision K—
- Updated Specifications

Changes in Revision J—
- Updated ATEX compliance information
- Updated Declarations

Changes in Revision H—
- Updated Regulatory Compliance information

Changes in Revision G—
- Added Notice to mark nameplates (page 7)

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00321-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	USOV Stop Valves, nominal sizes 2 inch and 3 inch
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/68/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment PED Category II
Applicable Standards:	ASME B31.3 Process Piping, 2012 ASME Boiler and Pressure Vessel Code VIII, Div. 1, 2010
Conformity Assessment:	PED Module H – Full Quality Assurance, CE-0041-PED-H-WDI 001-16-USA, Bureau Veritas UK Ltd (0041) Parklands, 825a Wilmslow Road, Didsbury, M20 2RE Manchester

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

MANUFACTURER

Signature

Christopher Perkins
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

22-APR-2016
Date

5-09-1183 Rev 24

TOPWORX

EU Declaration of Conformity

We, the undersigned,

TopWorx
3300 Fern Valley Road
Louisville, Kentucky 40213
United States of America

With Certificate and Notification,

EC Type Examination Certificate
Baseefa 08ATEX0360X

SGS Baseefa Ltd., Rockhead Business Park, Staden Lane,
Buxton, Derbyshire SK17 9RZ

Quality Assurance Notification - Sira Certification Service
Rake Lane, Eccleston, Chester, CH4 9JN, UK
NB# 0518

Certify and declare under our sole responsibility that the following apparatus:

TopWorx Go Switch™

Model 7X-XXXXX-XX1549

Ex db IIC T* Gb
Ex tb IIIC T* Db

Reference certificate for
specific markings

Conforms to the essential requirements of the UNION Directive 2014/34/EU,
based on the following standards applied, of latest issues, including amendments:

EN 60079-0:2012/A11:2013 EN 60079-1:2014 EN 60079-31:2014

The technical documentation is kept at the following address:

TopWorx
3300 Fern Valley Road
Louisville, Kentucky 40213
United States of America
+1.502.969.8000

J Pearce
Product Compliance
20 April 2016
Date

ES-03660-1 R5

Rose Enclosures
A Phoenix Mecano Company
7330 Executive Way,
Frederick, Maryland 21704
Tel: (301) 696-9800
Fax: (301) 696-9494
http://www.rose-bopla.com

ROSE
A Phoenix Mecano Company

Declaration of Conformity

Country of Origin: USA
Customer:
Woodward Governor Company
1000 East Drake Road
Fort Collins, CO 80525

We hereby declare in our sole responsibility, that the product

ROSE Ex-terminal enclosures (including connection facilities and conduit hubs): **0523201100**

Woodward Reference Number: 1626-10XX
1626-11XX
1626-12XX
1627-7XX

Which is the subject of this declaration, is in conformity with the following standards or Normative documents.

Applicable Standards: EN60079-0:2012, EN60079-15:2010

Markings: Ⓔx II 3 G, Ex nA II T5 Gc, IP66

According to the terms of the directive

ATEX-directive 94/9/EC (ATEX 100a)

Bruce Bator
Engineering Manager

P.11.131.3 April 4, 2014

Page 1 of 1

ISO 9001, ISO 14001, AS 9100
& TS 16949 CERTIFIED

G. W. LISK COMPANY, INC. 81983

ESTABLISHED 1910 2 SOUTH ST. CLIFTON SPRINGS, NY 14432-1195 315-462-2611 FAX 315-462-7661 www.GWLISK.com

DECLARATION OF CONFORMITY
According to ISO/IEC 17050

Manufacturer's Name:	G.W. Lisk Co. Inc.
Manufacturer's Address:	2 South Street, Clifton Springs, NY, USA
Model Name(s)/Number(s):	Solenoid Operated Valve Assemblies Type: M3-XXXX-(XX) Ex II 2G Ex d IIB T3 Gb Sira11ATEX1209X Ex II 3G Ex nA IIC T3 Gc Sira11ATEX4210X
Conformance to Directive(s):	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility. Directive 94/9/EC until 19 Apr 2016 Directive 2014/34/EU from 20 April 2016 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Standards - ATEX:	EN 60079-0:2009 - Explosive Atmospheres – Part 0: Equipment General Requirements. (A review against EN60079-0:2012, AMD 11:2013, which is harmonized, shows no significant changes relevant to this equipment so EN60079-0:2009 continues to represent "State of the Art"). EN 60079-1:2007 – Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures "D" EN 60079-15:2010 - Explosive Atmospheres - Part 15: Equipment Protection by Type of Protection "N".
Standards - IECEx:	IEC 60079-0:2007- Explosive Atmospheres – Part 0: Equipment - General Requirements. (A review against IEC 60079-0:2011, COR 2:2013, which is harmonized, shows no significant changes relevant to this equipment so IEC 60079-0:2007 continues to represent "State of the Art"). IEC 60079-1:2007 – Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures "D" (A review against IEC 60079-1:2014, which is harmonized, shows no significant changes relevant to this equipment so IEC 60079-1:2007 continues to represent "State of the Art"). IEC 60079-15:2010 - Explosive Atmospheres - Part 15: Equipment Protection by Type of Protection "N".
Common Standards:	EN 61000-6-2: 2005/COR:2005 - Generic Standard - Immunity for Industrial Environments. Evaluation has determined that this design is inherently immune to electrostatic discharge and surge voltages.
3rd Party Certifications:	IECEx – SIR 11.0102X
Notified Body For Production:	Baseefa NB Number 1180 Rockhead Business Park Staden Lane Buxton, Derbyshire SK17 9RZ United Kingdom www.baseefa.com

On behalf of the above named company, I declare that on the date the equipment accompanied by this declaration is placed on the market, the equipment specified above conforms with all technical and regulatory requirements of the above listed Directive(s)

Signature	
Anthony J Green	Certified Product Authority/Quality Engineer
Full Name	**Position**
Date	13 Jun 16

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

File name:	00321-04-EU-02-02
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Names:	USOV Shutoff Valves, nominal sizes 2 inch and 3 inch
This product complies, where applicable, with the following Essential Requirements of Annex I:	1.1, 1.2, 1.3, 1.5, 1.6, 1.7

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

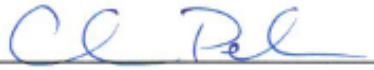
The person authorized to compile the technical documentation:

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

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

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

MANUFACTURER



Signature

Christopher Perkins

Full Name

Engineering Manager

Position

Woodward Inc., Fort Collins, CO, USA

Place

05-APR-2016

Date

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

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Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26307.

B 2 6 3 0 7 : P

PO Box 1519, Fort Collins CO 80522-1519, USA
1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

Email and Website—www.woodward.com

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

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