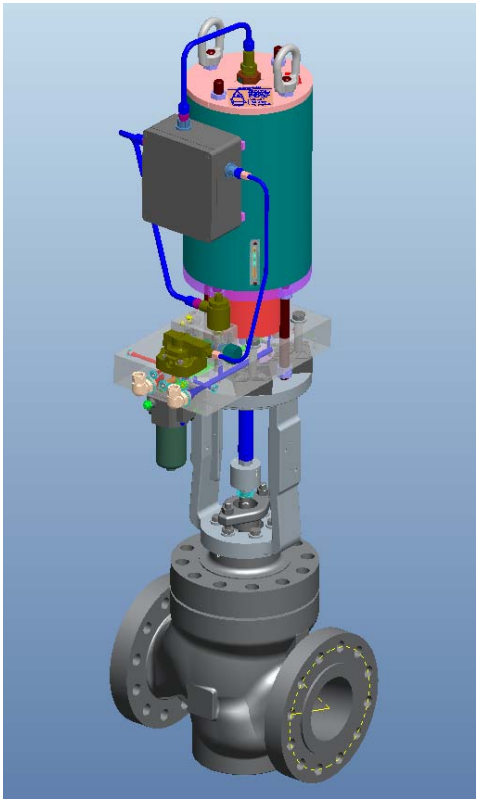
WOODWARD

Product Manual 26663
(Revision A)
Original Instructions



6-inch HGV (Hydraulic Globe Valve) Gas Fuel Throttle Valve

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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, 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 *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, 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 Out-of-date translations are marked with ⚠.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—Changes in this publication since the last revision are indicated by a black line alongside the text.

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol. It is 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.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control 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

Suitability for use in North American Hazardous Locations is the result of compliance of the individual components:

DCDT: ETL Certified for Class I, Division 2, Groups A, B, C, D. For use in Canada and the United States. ETL 9700663

Servovalve: CSA Certified for Class I, Division 2, Groups A, B, C, D, T3 at 125 °C. For use in Canada. CSA 155495-1072373

FM Certified for Class I, Division 2, Groups A, B, C, D, T3A at 135 °C. For use in the United States. FM per **www.approvalguide.com**

Solenoid Trip: CSA Certified for Class I, Division 1, Groups C & D, Class I, Division 2, Groups A, B, C, D at 150 °C Ambient. For use in Canada and the United States. CSA 151336-1260548

Junction Box: Class I, Zone 1, AEx e II, Class I, Zone 1, Ex e II. For use in the United States and Canada. UL E203312

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

Field Wiring must be suitable for at least 93 °C.

The wiring junction box provides earth ground terminals if needed for a separate earth ground to meet wiring requirements.

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

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

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

⚠AVERTISSEMENT

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

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

Chapter 1.
General Information

Introduction

The HGV (Hydraulic Globe Valve) Gas Fuel Throttle Valve controls the flow rate of natural gas fuel to various stages of an industrial gas turbine combustion system. The unique design integrates the valve and actuator into a cost-effective, compact assembly. The valve is designed to provide a highly accurate flow-versus-stroke characteristic. The actuator is a single-acting spring-loaded design that will quickly close the valve upon loss of electrical or hydraulic signals. An onboard hydraulic filter is designed into the manifold to augment the reliability of the servovalve and actuator. The servovalve is an electrically redundant dual coil design. A dc-powered DCDT provides feedback for the actuator.

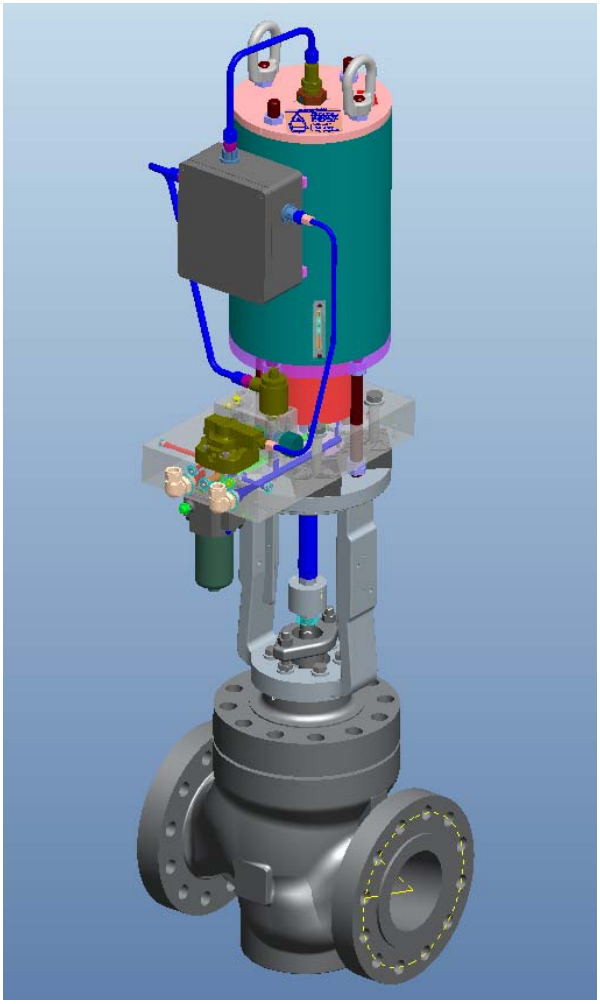


Figure 1-1. Gas Fuel Throttle Valve

Gas Fuel Throttle Valve Function Characteristics

Functional Requirement	High Pressure Version – DCDT mA Output
Valve Type	Two way—globe style, plug guided metering valve
Trim Configuration	Approximate equal percentage flow curve
Type of Operation	Run—valve open, Trip—valve closed
Fluid Ports	ANSI Class 600 flanges Size 6”
Flowing Media	Natural gas - Materials should be NACE MR0175 compatible. CF3M stainless steel body and stainless steel stem and trim currently used
Maximum Gas Pressure in respect to valve balancing criteria only	4068 kPa (590 psig)
Valve Proof Pressure Level (Prod. Test) per ANSI B16.34, ANSI B1637/ISA S75.19 (Prod. Test)	15341 kPa (2225 psig)
Minimum Valve Burst Pressure (Proto Test)	46 540 kPa (7400 psig)
Gas Filtration	25 µm absolute
Gas Temperature	–18 to +187 °C (0 to 369 °F)
Max Cv Values	Cv Max = 320
Valve Ambient Temperature	–29 to +60 °C (–20 to +140 °F)
Shutoff Classification (Prod. Test)	Class IV per ANSI B16.104/FCI 70-2 (0.01% of rated valve capacity at full travel measured with air at 345 kPa/50 psid)
External Leakage	None (Prod Test)
Combined Influence of Hysteresis, Linearity, and Repeatability	±0.5% of full scale with closed loop PI control (Proto. Test)
Hydraulic Fluid Type	Petroleum based hydraulic fluids as well as fire resistant hydraulic fluids such as Fyrquel
Hydraulic Supply Pressure	12 500 to 15 996 kPa (1813 to 2320 psig), (design at 15 996 kPa/2320 psig)
Production Proof Hydraulic Test Fluid Pressure Level (Prod. Test)	23 995 kPa (3480 psig) minimum
Minimum Design Actuator Burst Pressure (Proto. Test)	39 990 kPa (5800 psig) minimum
Fluid Filtration and Cleanliness Level Required	10–15 µm absolute, cleanliness per ISO 4406 Code 18/16/13 maximum, 16/14/11 recommended
Filter Differential Indication	Visual Indicator
Hydraulic Fluid Temperature	0 to 74 °C (32 to 165 °F)
Trip Mechanism	Electric solenoid, 90–140 Vdc (125 Vdc nominal), 83 mA nominal current
Trip Time (Prod. Test)	Less than 0.300 s and greater than 0.100 s
Slew Time (Prod. Test)	5% to 95% in less than 2 s, 95% to 5% in less than 1 s
Dual Coil Servovalve Input Current Rating	–30 to +30 mA (plus a null bias 3.0 mA) total (for two coils) (0 mA results in valve closing)
DCDT Position Transducer Feedback	Dual Feedback

Functional Requirement	High Pressure Version – DCDT mA Output
DCDT Input	24 ±4.8 Vdc, 30 mA one channel
DCDT Output	4 to 20 mA for 100% of available stroke, 20 mA at valve closed position
Hazardous Locations Requirements	Listed Components will meet a minimum of: North American Class I, Division 2, Groups B, C, D
Hydraulic Fluid Connections	Supply pressure: 0.750 tube fitting, 90° positionable elbow, Drain pressure: 0.750 tube fitting, 90° positionable elbow
Gas Fuel Vent Connection	0.4375-20 UNF straight thd port (-4)
Sound Level	< 100 dB at full flow conditions

Gas Fuel Throttle Valve Description

The metering valve is a pressure-balanced Flowserve Mark 100 valve with the following options:

Feature	Option
Valve Model/ Body Type	Mark 100/Globe/MegaStream
Size / Pressure Class	6 inch/ Class 600
Trim #/ Characteristic	5/Equal Percent
Stages/Pass Size/Ret Guiding	2 Stage/A/Cage
Flow Direction	Flow Under
Trim Type	Pressure Balance O-ring/Viton & PEEK
Guides Upper/Lower	316 SS &Graphite/Alloy 6
Packing	Sureguard XT/ Twin with Interseal Vent/ Live Loaded

For additional information on the installation and maintenance of the valve, see Woodward manual 26679.

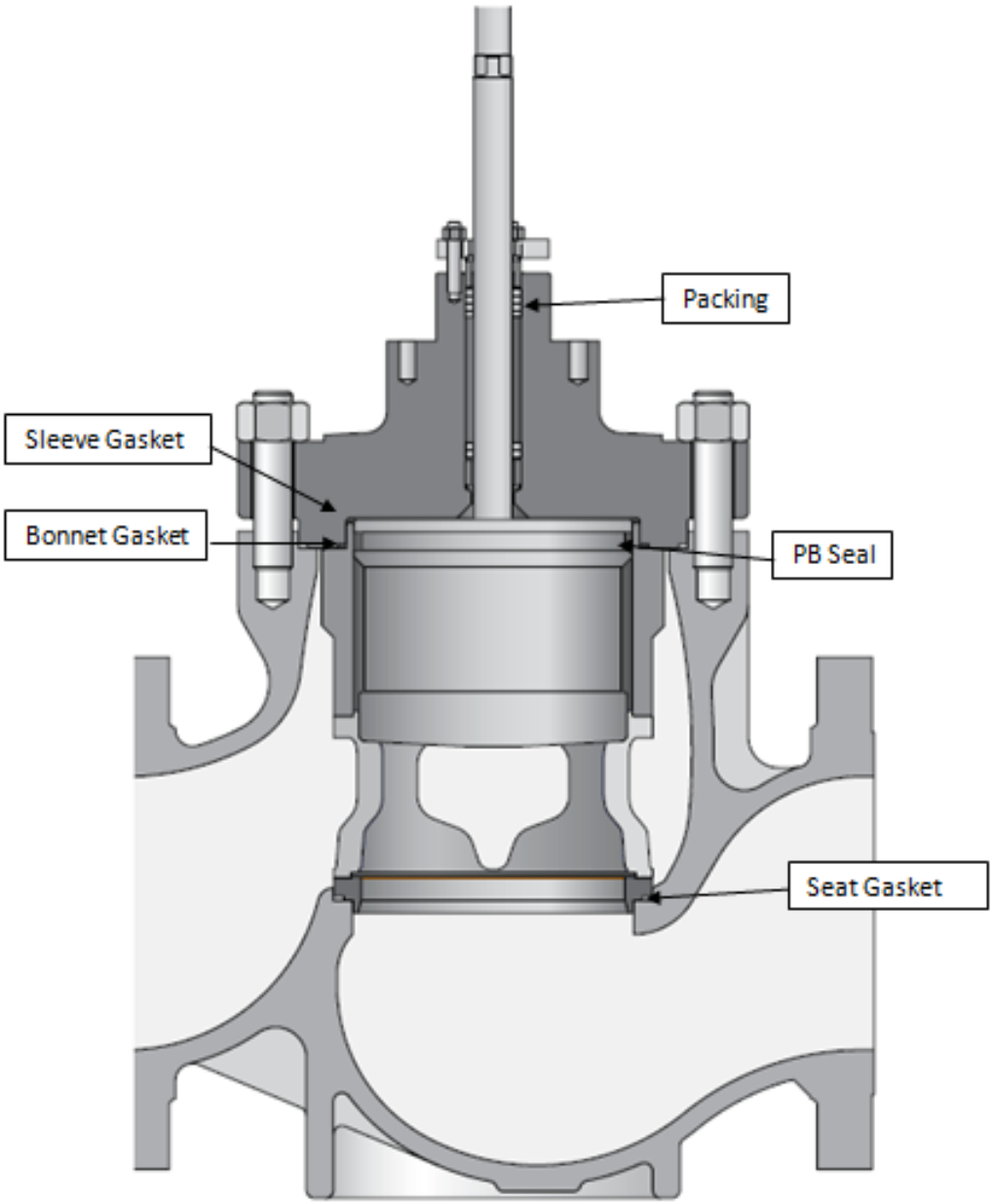


Figure 1-2. Cutaway, Metering Valve

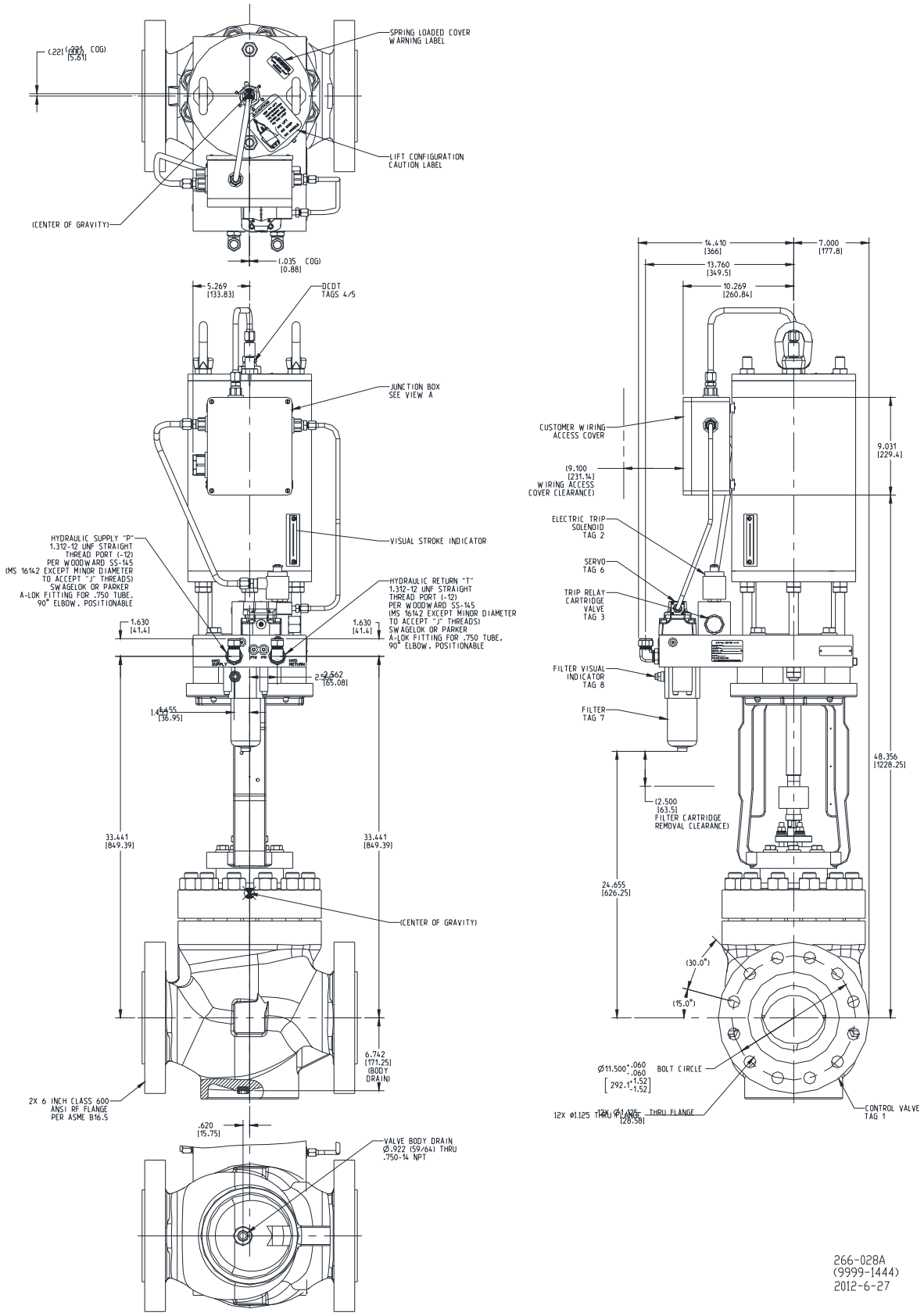


Figure 1-3a. Outline Drawing

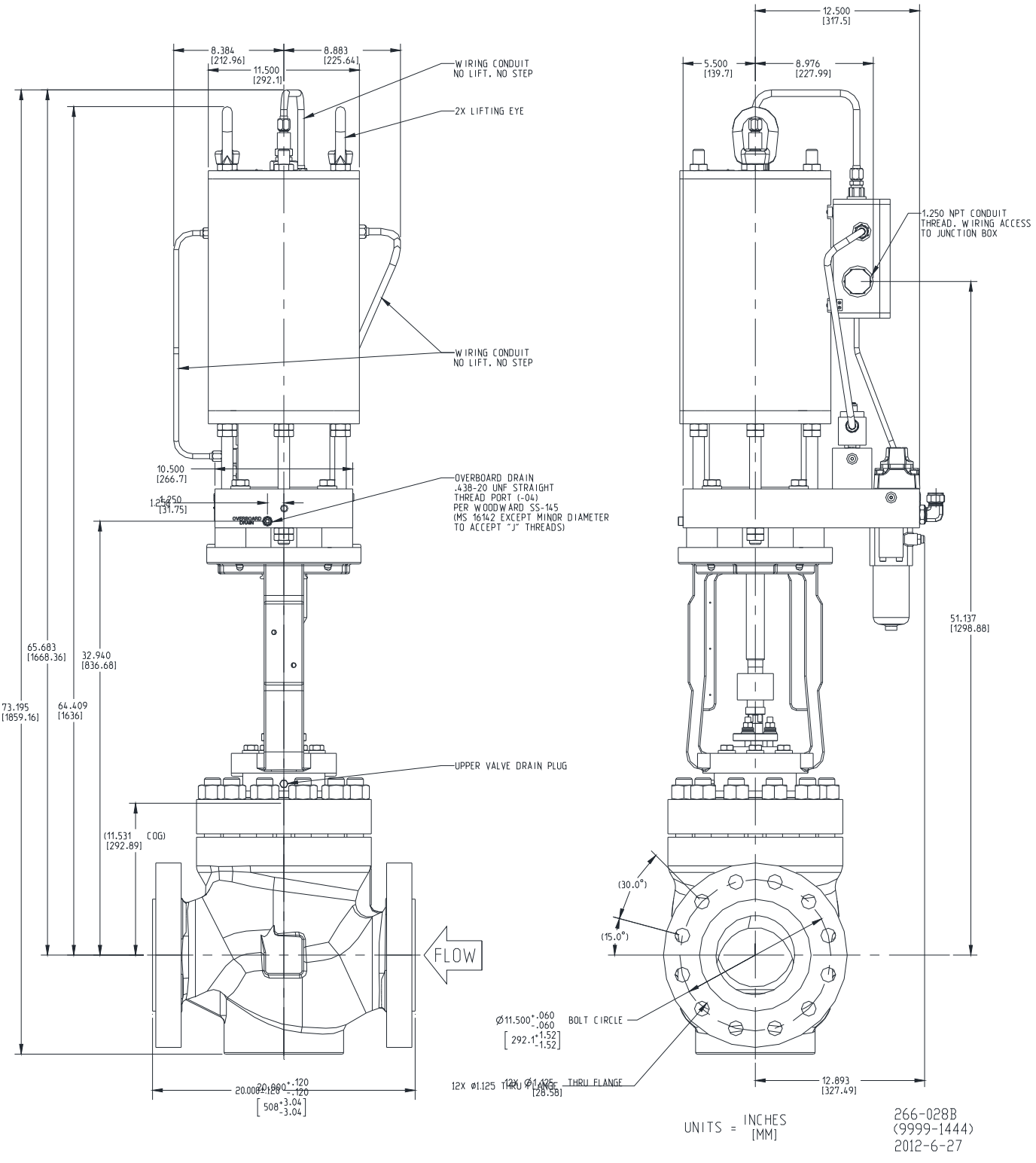


Figure 1-3b. Outline Drawing

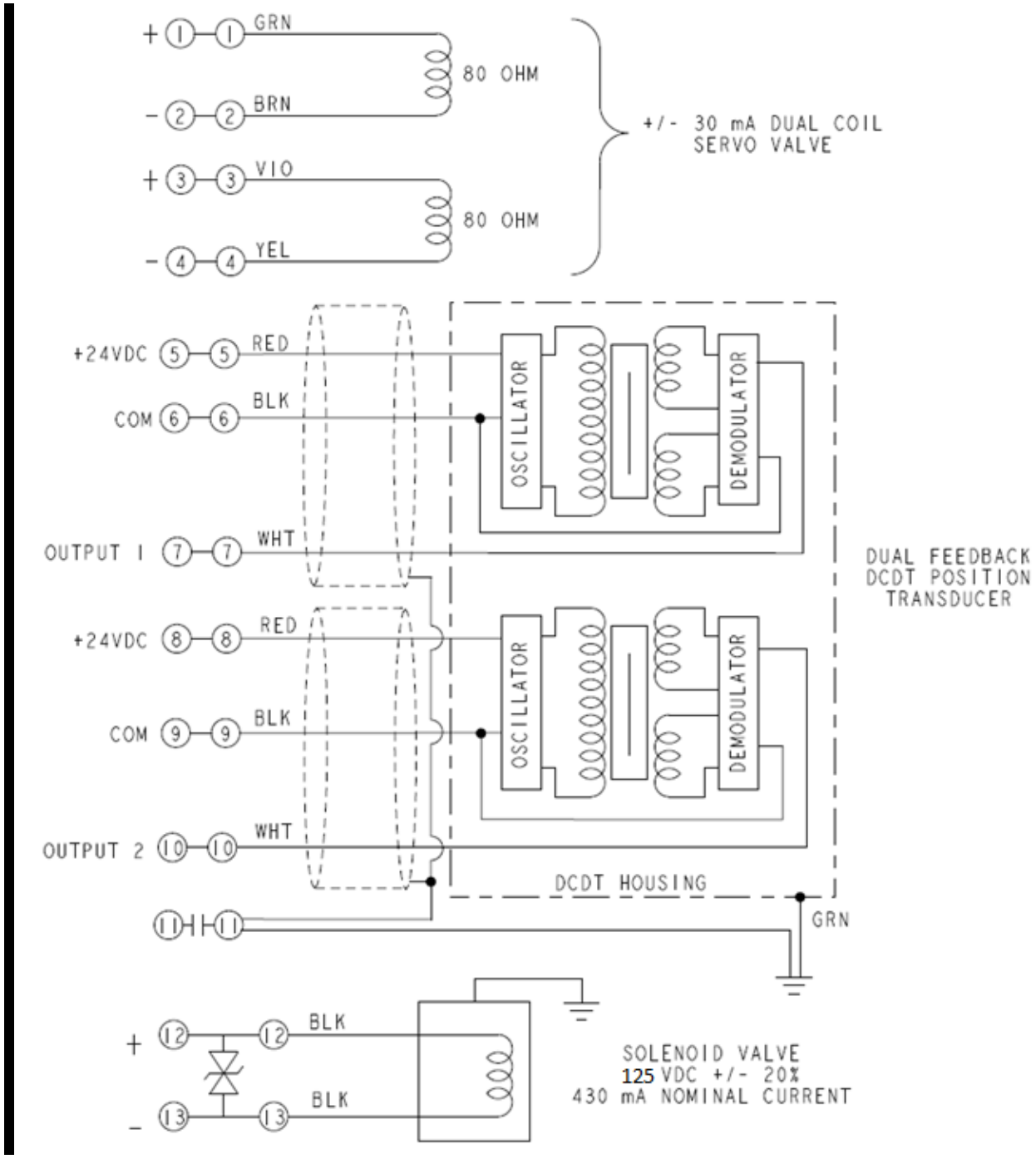


Figure 1-4. Wiring Diagram for TXP/T3000 Controller with Dual mA DCDT

Chapter 2.
Description

Dual Coil Electrohydraulic Servovalve Assembly

The hydraulic actuator assembly uses a two-stage hydraulic servovalve to modulate the position of the actuator output shaft and thereby control the gas fuel valves. The first stage torque motor utilizes a dual-wound coil, which controls the position of the first and second stage valves in proportion to the total electric current applied to the two coils.

If the control system requires a rapid movement of the valve to send more fuel to the turbine, total current is increased well above the null current. In such a condition, control port PC1 is connected to supply pressure. The flow rate delivered to the piston cavity of the actuator is proportional to the total current applied to the three coils. Thus, the opening velocity is also proportional to the current (above null) supplied to the torque motor.

If the control system requires a rapid movement to close the gas fuel valve, the total current is reduced well below the null current. In such a condition, port PC1 is connected to the hydraulic drain circuit. The flow rate from the piston cavity to drain is proportional to the magnitude of the total current below the null value. Thus, the closing velocity is also proportional to the current (below null) supplied to the torque motor.

Near the null current, the four-landed valve isolates the control port from the hydraulic supply and drain, balancing the piston pressure against the spring to maintain a constant position. The control system, which regulates the amount of current delivered to the coils, modulates the current supplied to the coil to obtain proper closed loop position of the valve.

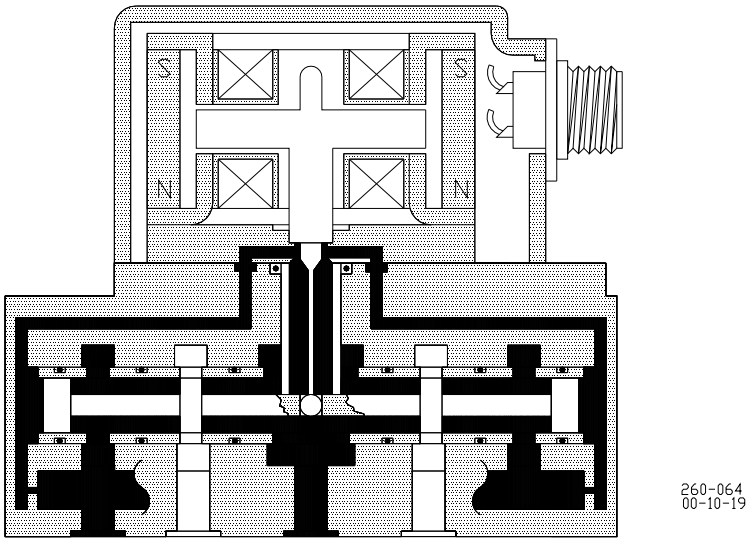


Figure 2-1. Servovalve Cutaway

Trip Relay Valve Assembly

The Fuel Gas Throttle valve uses a solenoid-operated trip relay circuit to operate a high capacity, three-way two-position, hydraulically-operated valve which quickly closes the Gas Fuel Throttle valve. This trip relay circuit consists of four functional elements. These include the trip relay solenoid valve, the trip relay supply orifice, the hydraulically operated trip valve, and the trip relay volume.

In the normal run mode, the trip relay solenoid valve is closed, which prevents the trip relay volume from bleeding to the hydraulic return. As a result, high pressure oil is fed into the trip relay circuit through the supply orifice, which quickly pressurizes the trip circuit to supply pressure. When the trip circuit pressure increases above (124 to 207) kPa / (18 to 30) psig, the three-way relay valve shifts position so that the common port connects the control port of the servo-valve to the lower piston cavity of the actuator, allowing the servo-valve to position the throttle valve.

Hydraulic Filter Assembly

The valve is supplied with an integrated, high-capacity filter. The broad range filter protects the internal hydraulic control components from large oil-borne contaminants that might cause the hydraulic components to stick or operate erratically. The filter is supplied with a visual indicator to indicate when the recommended pressure differential has been exceeded, and when replacement of the element is necessary.

DC Powered LVDT (DCDT) Position Feedback Sensor

The Gas Fuel Throttle valves use a DCDT feedback device with integral excitation and demodulation circuitry. The device uses a dc supply voltage to generate a feedback signal. Single V (dc) and dual V (dc) or mA feedback devices are used depending on the application.

Chapter 3. Installation

General

See the outline drawings (Figures 1-3) for:

- Overall dimensions
- Process piping flange locations
- Hydraulic fitting sizes
- Electrical connections
- Lift points and center of gravity
- Weight of the valve

Installation attitude does not affect actuator or fuel valve performance, but a vertical position is generally preferred to conserve floor space as well as ease of making electrical, fuel, and hydraulic connections and changing the hydraulic filter element. The gas fuel throttle valve is designed for support by the piping flanges alone; additional supports are neither needed nor recommended. Do not use this valve to provide support to any component other than the piping to which it is directly connected.

The orientation of the visual position indicator may be changed to accommodate surrounding obstructions, if any. See Chapter 4 for instructions to change the orientation.

⚠WARNING

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

⚠WARNING

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

⚠WARNING

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

Do not lift or handle the valve by any conduit. Lift or handle the valve only by using the eyebolts.

Unpacking

The valve is shipped in an airtight bag with desiccant to ensure a non-corrosive environment. We recommend that the valve be kept in its shipping container until installation. If the valve is to be stored for extended periods of time, encase the valve in an airtight container with desiccant.

Piping Installation

Refer to ASME B16.5 for details of flange, gasket, and bolt types and dimensions.

This is a globe-style valve. Verify that the process piping face-to-face dimensions meet the requirements of the outline drawings (Figures 1-3) within standard piping tolerances. The valve should mount between the piping interfaces such that the flange bolts can be installed with only manual pressure applied to align the flanges. Mechanical devices such as hydraulic or mechanical jacks, pulleys, chain-falls, or similar should never be used to force the piping system to align with the valve flanges.

Flange gasket materials should conform to ANSI B16.20. The user should select a gasket material which will withstand the expected bolt loading without injurious crushing, and which is suitable for the service conditions.

When installing the valve into the process piping, it is important to properly torque the stud/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 torque. Once all studs/bolts have been torqued to half the appropriate value, repeat the pattern until the rated torque value calculated per ASME Boiler Pressure Vessel Code Section VIII, Division 1 Appendix 2 is obtained.

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

Hydraulic Connections

There are two hydraulic connections that must be made to each valve: supply and return oil. The connections to the valve are 0.75 OD tube fittings. The tubing up to the valve must be constructed to eliminate any transfer of vibration or other forces into the valve.

Make provisions for proper filtration of the hydraulic fluid that will supply the actuator. The system filtration should be designed to assure a supply of hydraulic oil with a maximum ISO 4406 contamination level of 18/16/13 and a preferred level of 16/14/11. The filter element included with the actuator is not intended to provide adequate filtration over the entire life of the actuator.

The hydraulic supply to the actuator needs to be 19.05 mm (0.750 inch) tubing capable of supplying 38 L/min (10 US gallons/min) at (12 500 to 15 996) kPa / (1813 to 2320) psig.

The hydraulic drain should be 19.05 mm (0.750 inch) tubing and must not restrict the flow of fluid from the valve. The drain pressure must not exceed 207 kPa (30 psig) under any condition.

Electrical Connections

WARNING

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

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagram (Figure 1-4).

The use of cable with individually-shielded twisted pairs is required. The DCDT position feedback lines should be shielded to prevent picking up stray signals from nearby equipment. Connect the shields at the control system side ***and*** to the appropriate terminal in the HGV junction box as specified by the system wiring diagram. DO NOT attempt to ground the DCDT feedback shield directly to earth on the HGV side or a ground loop condition will occur.

Installation Notes

- Wires exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches).
- The shield termination wire (or drain wire) should be kept as short as possible, not exceeding 50 mm (2 inches); and where possible the diameter should be maximized.
- Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.

Failure to provide shielding can product future conditions which are difficult to diagnose. Proper shielding at the time of installation is required to ensure satisfactory operation of the product.

Fuel Vent Port

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

Chapter 4.
Maintenance and Hardware Replacement

Maintenance

The Gas Fuel Throttle Valve requires no maintenance or adjustment for operation.

Woodward recommends routine checks of the DP gauge on the filter assembly to verify that the filter is not partially clogged. If the DP indicator shows red, the filter element needs to be replaced.

Woodward recommends routine checks of the fugitive gas sensor. If the sensor indicates excessive gas leakage, the seals need to be replaced.

In the event that any of the standard components of the valve become inoperative, field replacement is possible. Contact a Woodward representative for assistance. Replacement spare parts kit is Woodward #8923-1917.

Hardware Replacement

⚠WARNING

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

⚠WARNING

Do not lift or handle the valve by any conduit. Lift or handle the valve only by using the eyebolts.

⚠WARNING

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

⚠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

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.

To facilitate field replacement of items, spare parts should be kept on-site. See the outline drawing (Figures 1-3) for the locations of items. Contact Woodward for a complete list of field-replaceable parts and additional instructions for their replacement.

Hydraulic Filter Assembly/Cartridge

The hydraulic filter is located on the hydraulic manifold. It is hanging directly under the servovalve.

Replacement of Filter Assembly:

NOTE—For replacement of filter assemblies without the electric filter alarm, only steps 4-11 apply.

1. Remove the cover to the electrical junction box.
2. Disconnect the filter alarm switch wires from the connector blocks.
3. Loosen the conduit fittings from the electrical box, the filter alarm switch, and the tee fitting in between.
4. Carefully remove the conduit from the filter alarm switch and pull the wiring out of the conduit.
5. Remove the four 0.312-18 socket head cap screws.
6. Remove the filter assembly from the manifold block. ***The filter will contain a large amount of hydraulic fluid. Be cautious when handling.***
7. Verify that two O-rings are present in the interface between the filter and the manifold.
8. Obtain a new filter assembly from Woodward.
9. Verify that two new O-rings are present in the new filter assembly.
10. Install the filter assembly onto the manifold. Be sure to place the filter in the correct orientation. See the outline drawing (Figures 1-3).
11. Install the four 0.312-18 cap screws through the filter and torque to (27.6 to 28.9) N·m / (244 to 256) lb-in.
12. Install wiring through the conduit and into the electrical box.
13. Connect the conduit to the filter alarm switch and torque to (51 to 62) N·m / (450 to 550) lb-in.
14. Torque the conduit to the electrical box and the tee fitting to (51 to 62) N·m / (450 to 550) lb-in.
15. Install wires into the filter alarm switch connector blocks labeled according to Figure 1-4. If it is necessary to cut wires for installation, be sure to retain at least one service loop of wiring.
16. Replace the cover onto the junction box and tighten the screws.
17. Check for external leakage upon pressurizing the hydraulic system.

Replacement of Filter Cartridge:

1. Using a 1-5/16 wrench, loosen the bowl from the filter assembly.
2. ***The filter bowl will contain a large amount of hydraulic fluid. Be cautious when handling.***
3. Remove the filter element by pulling straight down from the rest of the assembly.
4. Obtain a new filter element from Woodward.
5. Lubricate the O-ring on the inside diameter of the cartridge with hydraulic fluid.
6. Install the cartridge into the assembly by sliding the open end of the cartridge onto the nipple.
7. Install the filter bowl onto the assembly. Tighten only by hand. Do not torque the bowl.
8. Check for external leakage upon pressurizing the hydraulic system.

Trip Relay Valve Cartridge

The trip relay valve cartridge is located in the e-trip block mounted to the hydraulic manifold block.

1. Using a 1-1/2 inch wrench (~38+ mm), loosen the trip relay valve from the e-trip block.
2. Slowly remove the cartridge from the manifold. ***There could be a substantial amount of hydraulic fluid upon removal. Be cautious when handling.***
3. Obtain a new trip relay valve cartridge from Woodward.
4. Verify that all O-rings are present on the new cartridge.
5. Lubricate the O-rings with hydraulic fluid or petroleum jelly.
6. Install the cartridge into the manifold housing.
7. Torque to (54 to 79) N·m / (40 to 58) lb-ft.
8. Check for external leakage upon pressurizing the hydraulic system.

Trip Relay Solenoid Valve

The trip relay solenoid valve is located on the side of the hydraulic manifold opposite the trip relay cartridge valve. See the outline drawing (Figures 1-3).

1. Remove the cover to the electrical junction box.
2. Disconnect the solenoid valve wires from the connector block labeled according to Figure 1-4.
3. Loosen the conduit fittings from the electrical box, the solenoid valve, and the tee fitting in between.
4. Carefully remove the conduit from the solenoid valve and pull the wiring out of the conduit.
5. Using a 1-1/4 inch wrench (~32– mm), loosen the solenoid valve from the hydraulic manifold.
6. Slowly remove the solenoid valve form the manifold. ***There could be some hydraulic fluid upon removal. Be cautious when handling.***
7. Obtain a new solenoid valve from Woodward.
8. Verify that both O-rings and back-up ring are present on the new valve.
9. Lubricate the O-rings with hydraulic fluid or petroleum jelly.
10. Install the new solenoid valve into the hydraulic manifold.
11. Torque the solenoid valve to (54 to 79) N·m / (40 to 58) lb-ft.
12. Install wiring through the conduit and into the electrical box.
13. Connect the conduit to the solenoid valve and torque to (51 to 62) N·m / (450 to 550) lb-in.
14. Torque the conduit to the electrical box and to the tee fitting to (51 to 62) N·m / (450 to 550) lb-in.
15. Install wires into the solenoid valve connector blocks labeled according to Figure 1-4. If it is necessary to cut the wires for installation, be sure to retain at least one service loop of wiring.
16. Replace the cover onto the junction box and tighten the screws.
17. Check for external leakage upon pressurizing the hydraulic system.

Servovalve

The servovalve is located on the hydraulic manifold directly above the filter assembly. See the outline drawing (Figures 1-3).

1. Remove the cover to the electrical junction box.
2. Disconnect the servovalve wires from the connector blocks labeled according to Figure 1-4.
3. Loosen the conduit fittings from the electrical box and the servovalve.
4. Carefully remove the conduit from the servovalve and pull the wiring out of the conduit.
5. Remove the four 0.312-18 UNF socket head cap screws holding the servovalve to the manifold.
6. Verify that all four O-rings are removed from the interface between the manifold and the servovalve.
7. Obtain a replacement servovalve from Woodward and verify part number and revision with the existing unit.
8. Remove the protective plate from the replacement servovalve and verify that O-rings are on all four counter bores of the servovalve.
9. Place the replacement servovalve onto the hydraulic manifold. Be sure to orient the servovalve to match the original orientation. Be sure that all four O-rings remain in their proper location during assembly.
10. Install four 0.312-18 UNF socket head cap screws and torque to (27.6 to 28.9) N·m / (244 to 256) lb-in.
11. Install wiring through the conduit and into the electrical box.
12. Connect the conduit to the servovalve and torque to (31 to 34) N·m / (270 to 300) lb-in.
13. Torque the conduit to the electrical box to (31 to 34) N·m / (270 to 300) lb-in.
14. Install wires into the servovalve connector blocks labeled according to Figures 1-5 and 1-6. If it is necessary to cut wires for installation, be sure to retain at least one service loop of wiring.
15. Replace the cover onto the junction box and tighten the screws.
16. Check for external leakage upon pressurizing the hydraulic system.

IMPORTANT

Every valve shipped contains documentation that gives the actual null current. It is imperative that the control system null current match the as-measured current for each valve in the system. Incorrect null current setting, with proportional control only, will result in position error.

DCDT

The DCDT is located on the top of the actuator. See the outline drawing (Figures 1-3).

1. Remove the cover to the electrical junction box.
2. Disconnect the DCDT wires from the connector blocks labeled according to Figure 1-4.
3. Loosen the conduit fittings from the electrical box and the DCDT.
4. Carefully remove the conduit from the DCDT and pull the wiring out of the conduit.
5. Remove the conduit from the electrical box.
6. Remove the protective covers from the four threaded tie rods that hold the actuator together. Remove the two “eye nuts” from the two-tie rods.
7. Remove the four 0.500-13 jam nuts from the tie rods.

8. Remove the two 0.250-20 socket head cap screws that hold the electrical box to the top mounting plate. The cap screws have nuts and washers.

WARNING

To prevent possible personal injury, do NOT completely remove the nuts in step 9 from the tie rods until you have verified that the preload has been removed from the springs.

9. Slowly remove the four remaining 0.500-13 nuts from the tie rods, rotating each nut one turn at a time. This will keep the cover and DCDT square with the housing. Failure to remove the nuts in this manner can cause the cover and DCDT body to become misaligned with the DCDT core rods, potentially damaging them.

   This action will release the preload on the integral springs of the actuator. The tie rod studs should be long enough to completely release the preload prior to coming off of the tie rods. Do NOT completely remove the nuts from the tie rods until you have verified that the preload has been removed from the springs; failure to comply could result in bodily injury.
10. The top plate should be free to be removed from the assembly. The DCDT will be removed with the top plate.
11. Remove the springs from the actuator.
12. Using a 0.750 crowfoot wrench and an extension, remove the core rod of the DCDT from the actuator piston. Be sure not to mix the old DCDT core rod and body with the replacement parts.
13. Using a 1-1/4 inch (~32– mm) wrench, remove the two 1.125-12 jam nuts from the DCDT housing.
14. Remove the DCDT from the top plate.
15. Install the new DCDT housing into the top plate and replace the two jam nuts. Do not tighten the jam nuts yet; the DCDT will need to be adjusted prior to use.
16. Install the new core rod into actuator piston using the 0.750 crowfoot wrench and an extension. Torque to (7.9 to 8.2) N·m / (70 to 73) lb-in.
17. Install the springs back into the actuator. Be sure that they are seated in the proper location.
18. Carefully replace the top plate and DCDT housing onto the actuator. Be sure that the DCDT housing is placed properly over the core rod.
19. Replace the electrical enclosure bracket onto the two appropriate studs.
20. Install four 0.500-13 nuts, one onto each stud. Slowly compress the springs into their cavity by rotating each nut one turn at a time. This will keep the cover and DCDT square with the housing. Failure to install the nuts in this manner can cause the cover and DCDT body to become misaligned with the DCDT core rods, potentially damaging them.
21. Torque the 0.500 nuts to (47 to 57) N·m / (35 to 42) lb-ft.
22. Install four additional 0.500-13 nuts onto the studs and torque to (24 to 28) N·m / (18 to 21) lb-ft.
23. Install the two 0.250-20 socket head cap screws that hold the electrical box to the top mounting plate. The cap screws have nuts and washers.
24. Torque the two cap screws to (6.6 to 8.8) N·m / (58 to 78) lb-in.
25. Replace the two “eye nuts” onto the two tie rods closest to the electrical box.
26. Replace the protective covers onto the tie rods.
27. Replace the conduit onto the electrical box.
28. Carefully replace the DCDT wires back through the conduit and into the electrical box.
29. Connect the conduit to the DCDT. Do not tighten.
30. Connect the DCDT wires to the connector blocks labeled according to Figure 1-4.
31. Replace the cover to the electrical box.

32. Verify that all hardware has been replaced onto the actuator and that all external fittings are torqued except for the lock nuts on the DCDT and the conduit on the DCDT.
33. Verify the excitation voltage to the DCDT.
34. Supply the actuator with hydraulics at 6206 kPa (900 psig).
35. Measure the DCDT output voltage using a high-quality digital voltmeter (select DC measurement mode).
36. With the actuator at minimum position, the output of the DCDT should be (20.00 ± 0.25) mA. If the readout is not within these specifications, adjust the DCDT in or out of the actuator by screwing the DCDT housing in or out of the top block. **NOTE—A small rotation of the DCDT will cause a substantial change in the readout.**
37. Once the proper current is obtained, carefully torque the bottom nut to (68 to 101) N·m / (50 to 75) lb-ft. Then torque the remaining nut to (34 to 50) N·m / (25 to 37) lb-ft.
38. Torque the conduit onto the DCDT to (51 to 62) N·m / (450 to 550) lb-in.
39. Set the 100 % position demand, measure the actual physical travel position, and adjust the span of the control channel such that the physical travel matches the full stroke of the actuator (7.6 cm / 3 inches).
40. Verify correct valve positions by commanding the control to 0 % and 100 %, and recheck the physical positions. (The DCDT feedback current, measured at the terminals in the electrical enclosure, should be approximately 20 mA with the valve closed and 4 mA with the valve open.)

Valve/Actuator Shaft Coupling

The valve/actuator shaft coupling mates the ends of the valve and actuator together. It is located within the valve yoke.

1. Obtain a replacement coupling from Woodward.
2. Remove the cover to the electrical junction box.
3. Remove all of the field wiring to the actuator.
4. Remove the conduit for the field wiring from the junction box.
5. Carefully pull the field wiring from the electrical junction box.
6. Disconnect the servovalve wires from the connector blocks labeled according to Figure 1-4.
7. Disconnect the solenoid valve wires from the connector block labeled according to Figure 1-4.
8. Loosen the conduit fittings from the electrical box to the servovalve and trip solenoid.
9. Carefully pull the wiring out of the electrical junction box.
10. Remove the spring can tie rod nuts under the hydraulic manifold. (see Figure 4-1)

⚠WARNING

To prevent possible serious personal injury or equipment damage, do NOT remove or disturb the tie rod nuts that mate directly to the top and bottom of the spring can. The springs in the spring can are significantly preloaded. Removing the spring can nuts can result in the loss of spring containment.

11. Lift the spring can off of the actuator cylinder using the eye bolts.
12. Cover the top of the actuator cylinder to prevent any contamination of the actuator piston and piston seals.
13. Remove the coupling from the actuator shaft (see Figure 4-2).
14. Loosen the coupling jam nut on the valve shaft.
15. Remove the coupling from the valve shaft.

16. Install the new coupling on the actuator shaft. Screw the coupling on until the threads bottom out.
17. Thread the jam nut onto the valve shaft until three threads remain beneath nut. Thread the valve side of the coupling on until it touches the jam nut.
18. Torque the actuator side of the coupling into the bottom of thread on the shaft to (163 to 190) N•m / (120 to 140) lb-ft.
19. Uncover the actuator cylinder and replace the spring can onto the actuator cylinder with the tie rods though the proper holes in the manifold so the conduits & junction box line up properly. Do Not install the tie rod nuts yet.
20. Check the gap between the bottom of the spring can and the top of the actuator cylinder is (1.27 to 4.32) mm / (0.050 to 0.170) inches.
21. Adjust the valve side part of the coupling to get the gap described in step 20.
22. Install the tie rod nuts under the hydraulic manifold. Torque the nuts that make contact with the manifold to (203 to 255) N•m / (150 to 188) lb-ft. Torque the jam nuts to (102 to 127) N•m / (75 to 94) lb-ft.
23. Carefully pull the wiring for the servo valve & trip solenoid into the electrical junction box.
24. Connect the conduit from the servovalve & trip solenoid to electrical junction box and torque to (31 to 34) N·m / (270 to 300) lb-in.
25. Torque the conduit to the electrical box to (31 to 34) N·m / (270 to 300) lb-in.
26. Install wires into the servovalve & trip solenoid connector blocks labeled according to Figure 1-4 . If it is necessary to cut wires for installation, be sure to retain at least one service loop of wiring.
27. Carefully pull the field wiring into the electrical junction box.
28. Connect the field wiring conduit to the junction box.
29. Install the field wiring according to figure 1-4.
30. Replace the cover onto the junction box and tighten the screws.

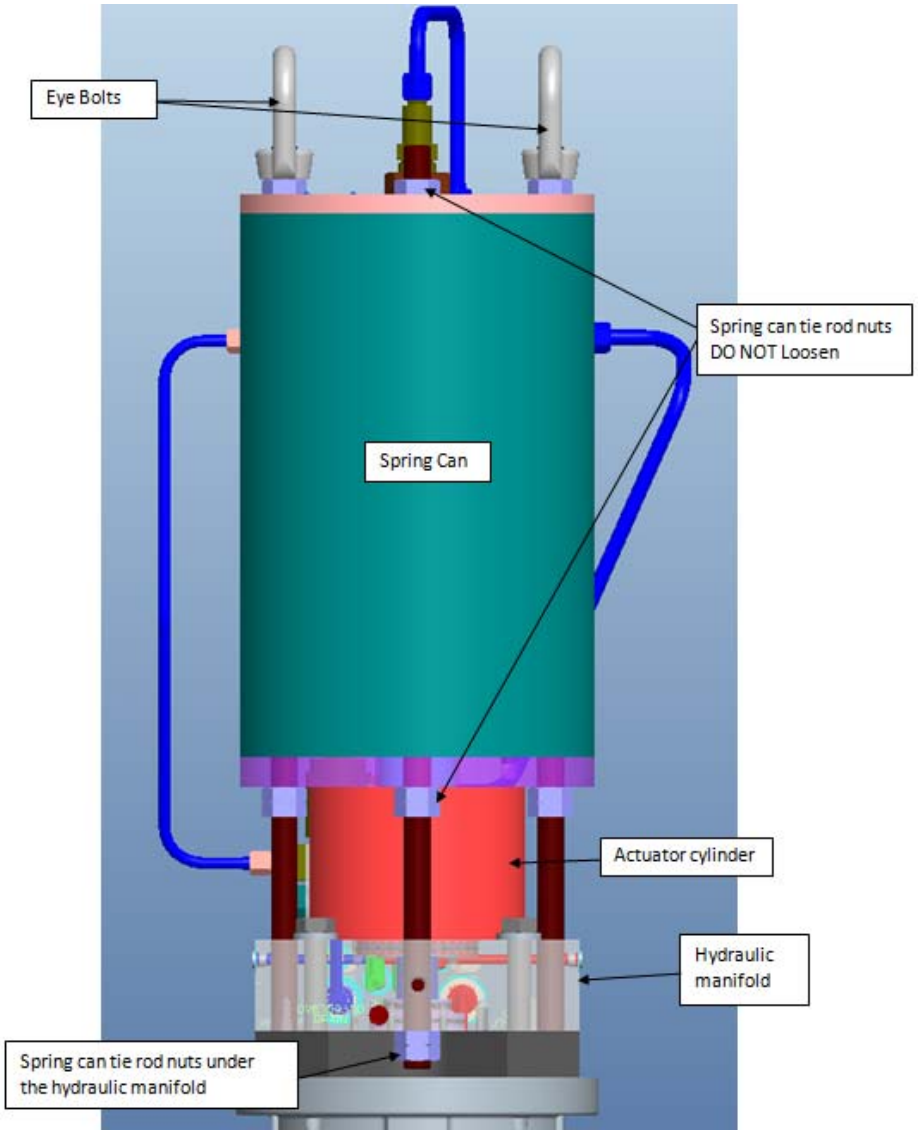


Figure 4-1. Spring Can Tie Rods/Nuts Detail

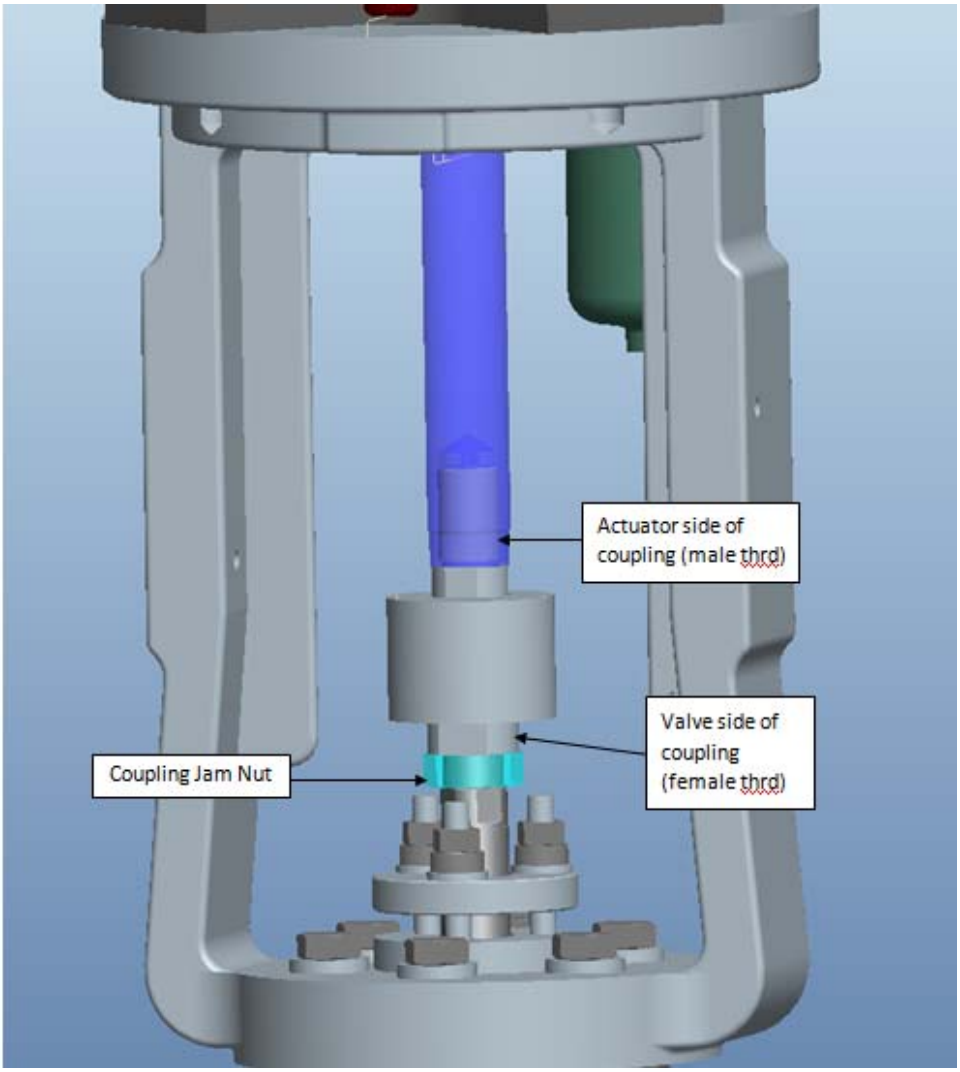


Figure 4-2. Actuator/ Valve Coupling Detail

Troubleshooting

Gas Fuel Throttle Valve not functioning correctly when using customer control system.

Perform steps 33 through 37 of the DCDT replacement procedure earlier in this chapter. Troubleshooting tool (Woodward part number 1008-4446) can be installed in place of the visual indicator to assist in mechanically determining valve stroke (verify that the valve is at the minimum position).

1. Remove two socket head cap screws holding the visual indicator onto the valve actuator.
2. Remove the visual indicator.
3. Using the same two cap screws, attach tool 1008-4446 (available from Woodward) to the actuator. Be sure to place the pin of the sliding piece onto the top of the piston within the actuator housing.
4. Using a customer-supplied travel indicator with a total stroke greater than 77.0 mm (3.03 inches) placed on top of the sliding piece of the tool, attach the indicator to the actuator housing. Zero the indicator.
5. Raise the servovalve current to (8.0 ± 0.5) mA. The valve should move fully open.

6. The maximum travel should be approximately 7.6 cm / 3 inches. If this value is not approximately 7.6 cm / 3 inches, contact Woodward for recommendations.
7. If this value is correct, check the feedback current of the DCDT. It should be 20 mA when the valve is closed and 4 mA when the valve is open.
8. If the feedback current is incorrect, verify that the excitation voltage is correct. If the excitation voltage is correct, and the DCDT output voltage does not match the values listed on the calibration sticker, contact Woodward for a replacement DCDT and follow the steps listed within this document for replacement.
9. If the feedback and physical stroke values match the recorded values supplied with the valve, then the control system is not functioning properly. Refer to the control system manufacturer for troubleshooting assistance.

Troubleshooting Charts

Faults in the fuel control or governing system are often associated with speed variations of the prime mover, but such speed variations do not always indicate fuel control or governing system faults. Therefore, when improper speed variations occur, check all components including the engine or turbine for proper operation. Refer to applicable electronic control manuals for assistance in isolating the trouble. The following steps describe troubleshooting for the gas fuel throttle valve.

Disassembly of the gas fuel throttle valve in the field is not recommended due to the dangerous forces contained in the springs. Under unusual circumstances where disassembly becomes necessary, all work and adjustments should be made by personnel thoroughly trained in the proper procedures.

When requesting information or service help from Woodward, it is important to include the part number and serial number of the valve assembly in your communication.

Symptom	Possible Causes	Remedies	
External hydraulic leakage	Static O-ring seal(s) missing or deteriorated	Replace O-rings fitted to user-serviceable components (filter, valve, trip relay valve) as needed. Otherwise, return actuator to Woodward for service.	
	Dynamic O-ring seal missing or deteriorated	Return valve to Woodward for service.	
Internal hydraulic leakage	Servovalve internal O-ring seal(s) missing or deteriorated	Replace servovalve.	
	Servovalve metering edges worn	Replace servovalve.	
	Piston seal missing or deteriorated	Return valve to Woodward for service.	
External gas fuel leakage	Piping flange gaskets missing or deteriorated	Replace gaskets.	
	Piping flanges improperly aligned	Rework piping as needed to achieve alignment requirements detailed in Chapter 3.	
	Piping flange bolts improperly torqued	Rework bolts as needed to achieve torque requirements detailed in Chapter 3.	
	Packing missing or deteriorated	Return valve to Woodward for service.	
Valve will not open	Servovalve command current incorrect. (The sum of the current through the two coils of the servovalve must be greater than the null bias of the servovalve for the gas valve to open.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figures 1-5 and 1-6) and the Customer system wiring schematic(s). Pay special attention to the polarity of the wiring to the servovalve and DCDT.	
	Servovalve failure	Replace servovalve.	
	Hydraulic supply pressure inadequate	Supply pressure for low-pressure version must be greater than 5171 kPa / 750 psig (6206 kPa / 900 psig preferred).	Supply pressure for high- pressure version must be greater than 12 500 kPa / 1813 psig (15 996 kPa / 2320 psig preferred).
	Trip relay cartridge valve failure	Replace cartridge valve.	
	Trip relay solenoid valve failure or check valve failure	Replace solenoid valve or check valve.	
	Filter element plugged	Check filter DP indicator. Replace element if the DP indicator shows red.	
Valve will not close	Servovalve command current incorrect. (The sum of the current through the three coils of the servovalve must be less than the null bias of the servovalve for the gas valve to close.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figures 1-5 and 1-6) and the Customer system wiring schematic(s). Pay special attention to the polarity of the wiring to the servovalve and DCDT.	
	Servovalve failure	Replace servovalve.	
	DCDT failure	Replace DCDT.	
	Springs broken	Return valve to Woodward for service.	
	Linkage broken	Return valve to Woodward for service.	
Valve will not respond smoothly	Hydraulic filter clogged	Check the differential pressure indicator on the filter housing.	
	Servovalve spool sticking	Verify hydraulic contamination levels are within recommendations of Chapter 1. The use of dither may improve performance in contaminated systems.	
	Servovalve internal pilot filter clogged	Replace servovalve.	
	Piston seal worn out	Return valve to Woodward for service.	
	Control system instability	Contact control system supplier.	
Actuator seals wear out prematurely	Hydraulic contamination level is excessive	Verify hydraulic contamination levels are within recommendations of Chapter 1. The use of excessive dither may reduce life in contaminated systems.	
	System is oscillating (seal life is proportional to distance traveled). Even small oscillations (on the order of ±1 %) at slow frequencies (on the order of 0.1 Hz) cause wear to accumulate rapidly.	Determine and eliminate the root cause of oscillation. Possible causes include inlet pressure regulation, control system setup, and improper wiring practices. See Chapter 3 Installation section for wiring recommendations.	

Chapter 5.
Service Options

Product Service 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 and 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 Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- 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.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing 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**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
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

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
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	

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

Revision History

Changes in Revision A—

- Updated outline drawings
- Updated valve characteristics and description
- Updated pressures and maintenance/replacement instructions

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26663A.

B26663:A

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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.

2013/1/Colorado