Released

WOODWARD

Product Manual 26276
(Revision AA, 10/2022)
Original Instructions

8-inch SS-260 Gas Stop/Ratio 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 *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 Out-of-date translations are marked with ⚠.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—Changes in this publication since the last revision are indicated by a black line alongside the text.

Contents

The following are trademarks of Woodward, Inc.:
Woodward

Illustrations and Tables

Warnings and Notices

Important Definitions

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

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

WARNING

Overspeed / Overtemperature / Overpressure

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

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

WARNING

Personal Protective Equipment

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

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

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

WARNING

Start-up

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

NOTICE

Battery Charging Device

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

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

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

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

Follow these precautions when working with or near the control.

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

Regulatory Compliance

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

EMC Directive: Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC). 2014/30EU is met by evaluation of the physical nature to the EMC protection requirement. Electromagnetically passive or "benign" devices are excluded from the scope of the Directive 2014/30/EU, however they also meet the protection requirement and intent of the directive.

Pressure Equipment Directive (Fisher Valve) Certified to Pressure Equipment Directive 2014/68/EU on the harmonization of the laws of the Member States relating to making pressure equipment available on the market.
Category III, Bureau Veritas CE-0062-PED-H-FVD 001-20-USA Module H. Fisher Controls International, LLC Declaration of Conformity is provided with each Gas Stop/Ratio Valve

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

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

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

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

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.

Pressure Equipment Directive (Actuator Portion): Compliant as "SEP" per Article 4.3 to Pressure Equipment 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.

Other International Compliance:

IECEx: Suitability for use in IECEx explosive atmospheres is the result of compliance of individual components:
Junction Box: Certified Ex e II, IIC T6, T5, T4 per IECEx PTB 08.0006
Servo Valve: Certified Ex nA IIC T4, T3 Gc per IECEx KEM 10.0041X
LVDT: Certified Ex nA IIC T4 Gc per IECEx SIR 11.0084X

TIIS: Applicable to the servo valve and LVDT. Where customer has requested TIIS compliance, the servo valve and LVDT are TIIS-marked and must be installed with barriers as shown in the Installation Chapter.

EAC Customs Union
These listings are limited only to those units with labels, marking, and manuals in Russian language to comply with their certificates and declaration.

EAC Customs Union (Marked): Certified to Technical Regulation CU 012/2011 for use in potentially explosive atmospheres per Certificate
RU C-US.МЩ06.B.00084 as 2Ex nA IIC T3 Gc X for electrical and II Gb c T3…T5 for non-electrical portions of the valve.

EAC Customs Union (Marked): Certified to Technical Regulation CU 032/2013 On the safety of equipment operating under excessive pressure per Certificate Certificate RU C-US.МЮ62.B.01729 – Category 3 valves (6 and 8 inch)

EAC Customs Union: Declared to Technical Regulation CU 032/2013 On the safety of equipment operating under excessive pressure. Declaration of Conformity Registration No: RU Д-US. МЮ62.B.01513 - Category 2 valves (3 and 4 inch)

EAC Customs Union: Declared to Technical Regulation CU 010/2011 On the safety of machinery and equipment. Declaration of Conformity Registration No: RU Д-US.МЩ06.B.00011.

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

Servo Valve: FM Certified for Class I, Division 2, Groups A, B, C, D for use in the United States per FM 4B9A6.AX.

CSA Certified for Class I Division 2, Groups A, B, C, D for use in Canada per CSA 1072373.

Junction Box: UL Listed for Class I, Zone 1: AEx e II, Ex e II, T6 for use in the United States and Canada per UL E203312.

LVDT: CSA Certified for Class I, Divisions 1 and 2, Groups A, B, C, D, T4 for use in the United States and Canada per CSA 151336-1090811

LVDT (Alternate): ETL Certified for Class I, Division 2, Groups A, B, C, D, T3 for use in the United States and Canada per ETL J98036083-003.

Solenoid: CSA Certified for Class I, Division 2, Groups A, B, C, D for use in the United States and Canada per CSA 1260548.

SIL Compliance:
SIL certification is available for specific Woodward item numbers. Please contact a Woodward representative for assistance.

Gas Stop/Ratio Valve – Certified SIL 3 Capable for safe position fuel shutoff function in safety instrumented systems. Evaluated to IEC 61508 Parts 1-7. Refer to the instructions of this Installation and Operation Manual, Chapter 6 – Safety Management – Safe Position Fuel Shutoff Function. SIL Certificate WOO 1905012 C001

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

Field Wiring must be suitable for at least 100°C.

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

T3 reflects conditions without process fluid. 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.

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

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

⚠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, Division 2 ou Zone 2.

Chapter 1.
General Information

The Woodward Gas Stop/Ratio Valve (Figure 1-1) performs a dual function for industrial or utility gas turbines. One function rapidly shuts off fuel to the turbine fuel control system. Another function provides accurate control of gas fuel pressure at the outlet of the stop/ratio valve. This pressure is applied to the inlets of the gas fuel control valve.

The Gas Stop/Ratio Valve features a modular design, and meets critical control characteristics while allowing the same valve design to accommodate a variety of stroke, force output, and mechanical interface arrangements. The electrical and mechanical interfaces have been designed for quick and easy assembly or removal of the valve, at the factory or in the field. The components include an on-board hydraulic filter, electrohydraulic servo valve, trip valve, single-acting hydraulic cylinder, and redundant LVDTs.

Optimum control of the gas turbine requires that the actuator and valve accurately and quickly track the demand signals transmitted by the control. The stop/ratio valve has been designed to provide output forces that exceed the opening and closing requirements with some margin. The additional margin helps ensure that the system moves rapidly even under service conditions where the valve has been contaminated or worn. The hydraulic trip relay valve has been selected to provide high operating force margins, high flow capacity, and to ensure the desired closure rate of the valve under trip conditions.

By using a long actuation rod between the hydraulic cylinder and the valve lever arm, the side-loading forces on the actuator shaft and seals are greatly reduced, decreasing the wear between sliding parts, and increasing the useful service life of the system. The ample distance between the wetted heavy-duty linear slide rings within the stop/ratio valve accommodates any remaining side load. These provisions provide extended service life even in severe service conditions.

This manual applies to 8-inch SS-260 Stop/Ratio Valves for industrial gas turbines. The primary differences between the three stop/ratio valve configurations shown in this manual are as follows:

Table 1-1. Primary Differences Between Stop/Ratio Valves

Feature			
SS-260 Fisher Valve	Flanged	Flangeless	Flanged
LVDT Redundancy	Dual	Triple	Triple
Trip Circuit Operating Pressure*	LP or HP	LP or HP	LP or HP
Junction Box	Aluminum	Aluminum	SST

IMPORTANT

Units may have either low pressure (LP) or high pressure (HP) trip valves. The trip circuit operating pressure is 100 psig (6.9 bar) for LP circuits and 1600 psig (110 bar) for HP circuits.

Table 1-2. Gas Stop/Ratio Valve Functional Characteristics

Functional Requirement	Gas Stop/Ratio Valve
Valve Type	Fisher Type 8" SS-260 Vee-Ball®
Process Fluid	Natural gas and syngas
Temperature Range	Natural gas 50 to 550 °F (10 to 288 °C) (heated fuel)
Position Accuracy	±1% full scale (over ±25 °F/±14 °C deviation from calibration)
Position Repeatability	±0.5% of point over the range of 10 to 100%
Hydraulic Fluid Type	Petroleum Based hydraulic fluids as well as fire resistant hydraulic fluids such as Fyrquel EHC
Operating Hydraulic Supply Pressure	1200 to 2400 psig (8274 to 16 552 kPa) (rated at 1600 psig/11 032 kPa)
Proof Test Fluid Pressure Level	2400 psig (16 548 kPa) minimum per SAE J214 (Prod Test)
Minimum Burst Fluid Pressure	6000 psig (41 370 kPa) minimum per SAE J214
Fluid Filtration Required	10–15 µm at 75 Beta
Hydraulic Fluid Contamination Level	Per ISO 4406 code 18/16/13 max, code 16/14/11 preferred
Hydraulic Fluid Temperature	+50 to +150 °F (+10 to +66 °C)
Actuator Ambient Temperature	–20 to +180 °F (–29 to +82 °C)
Vibration Test Level	Random 0.01500 gr²/Hz from 10 to 40 Hz ramping down to 0.00015 gr²/Hz at 500 Hz (1.04 Grms)
Shock	Limited to 30 g by servo valve
Trip Time	Less than 0.250 seconds (100–5% stroke)
Open Slew Time	5 to 95% in 0.630 ±0.27 seconds
Close Slew Time	95 to 5% in 0.630 ± 0.27 seconds
Trip Pressure (relative to hydraulic return pressure)	Low Pressure Trip Option: Pick up = 24 ±6 psid (165 ±41 kPa) Drop out = 22 ±6 psid (152 ±41 kPa) High Pressure Trip Option: Pick up = 750 ±100 psig (5171 ±690 kPa) Drop out = 750 ±100 psig (5171 ±690 kPa)
Hydraulic Fluid Connections	Trip Relay Pressure–1.062-12 UNF straight thread port (–12) Supply Pressure–1.312-12 UN straight thread port (–16) Return Port–1.625-12 UN straight thread port (–20)
Servo Input Current Rating	–7.2 to +8.8 mA (null bias 0.8 ±0.32 mA)
Servo Valve Flow Rating	15.0 US gal/min (56.8 L/min) at 1000 psid (6895 kPa) valve drop, 4-way
Servo Valve Rated Leakage	0.43 US gal/min (1.63 L/min) at 1500 psid (10 342 kPa)
Cylinder Bore	3.125 inch (79.38 mm) diameter
Stroke	6.00 inch (152.4 mm)
Static Seals	Elastomer per US MIL-R-83248 (Viton)
Paint	Two part Epoxy
Actuation Forces (opening at 1600 psig/11 034 kPa) (closing via spring)	Opening Force Fully Extended 4335 lb/19267 N Fully Retracted 7538 lb/33502 N Closing Force Fully Extended 7554 lb/33573 N Fully Retracted 4350 lb/19333 N
Design Availability Objective	Better than 99.5% over an 8760 hour period
Sound Level	Per Fisher-Rosemount Catalog 12
Weight	Flanged—975 lb (442 kg) Flangeless—880 lb (399 kg)

Note: Vee-Ball® is a trademark of Fisher-Rosemount.

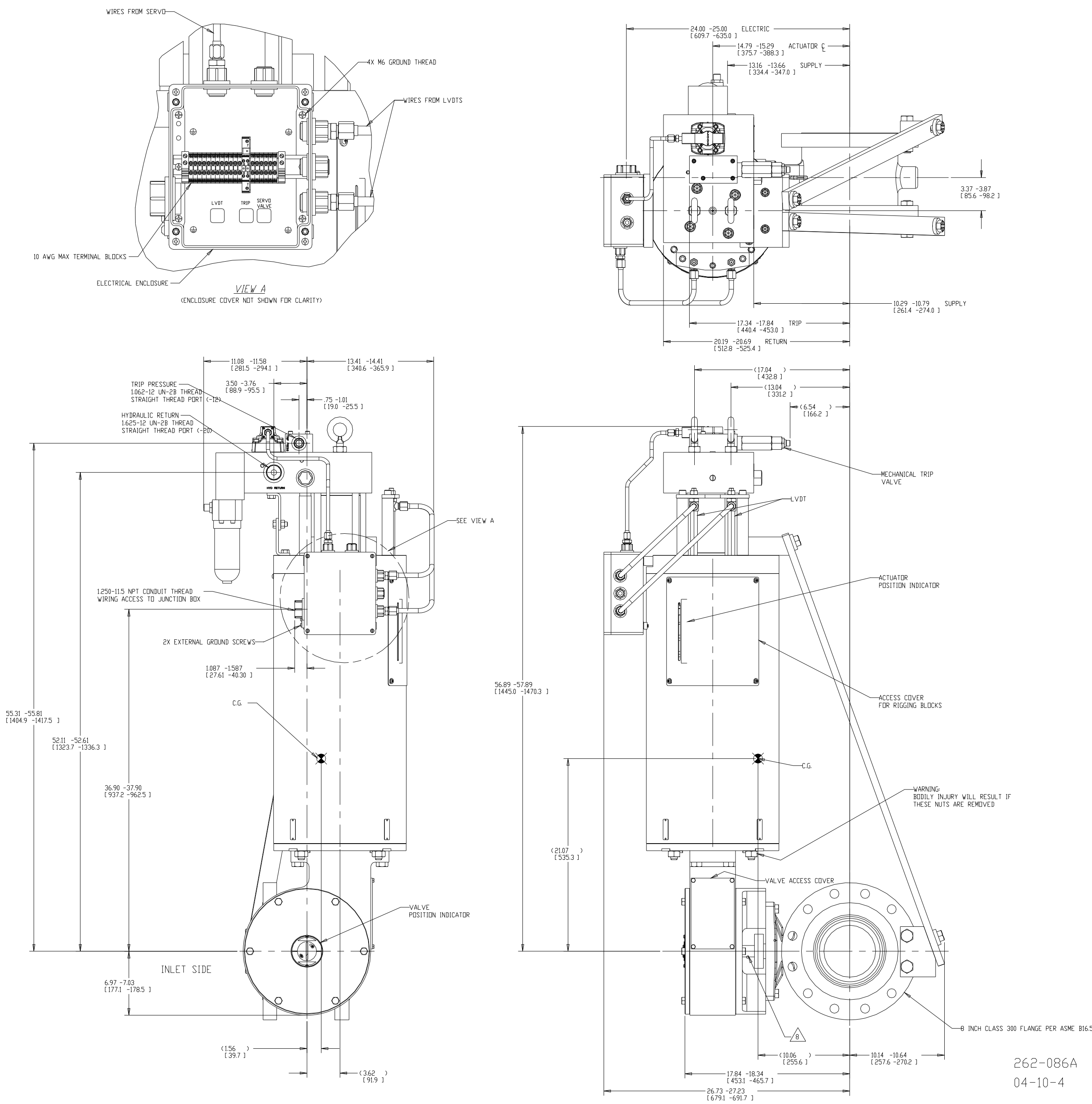


Figure 1-1a. 8-inch SS-260 Gas Stop/Ratio Valve Outline Drawing
(shown with high pressure trip valve)

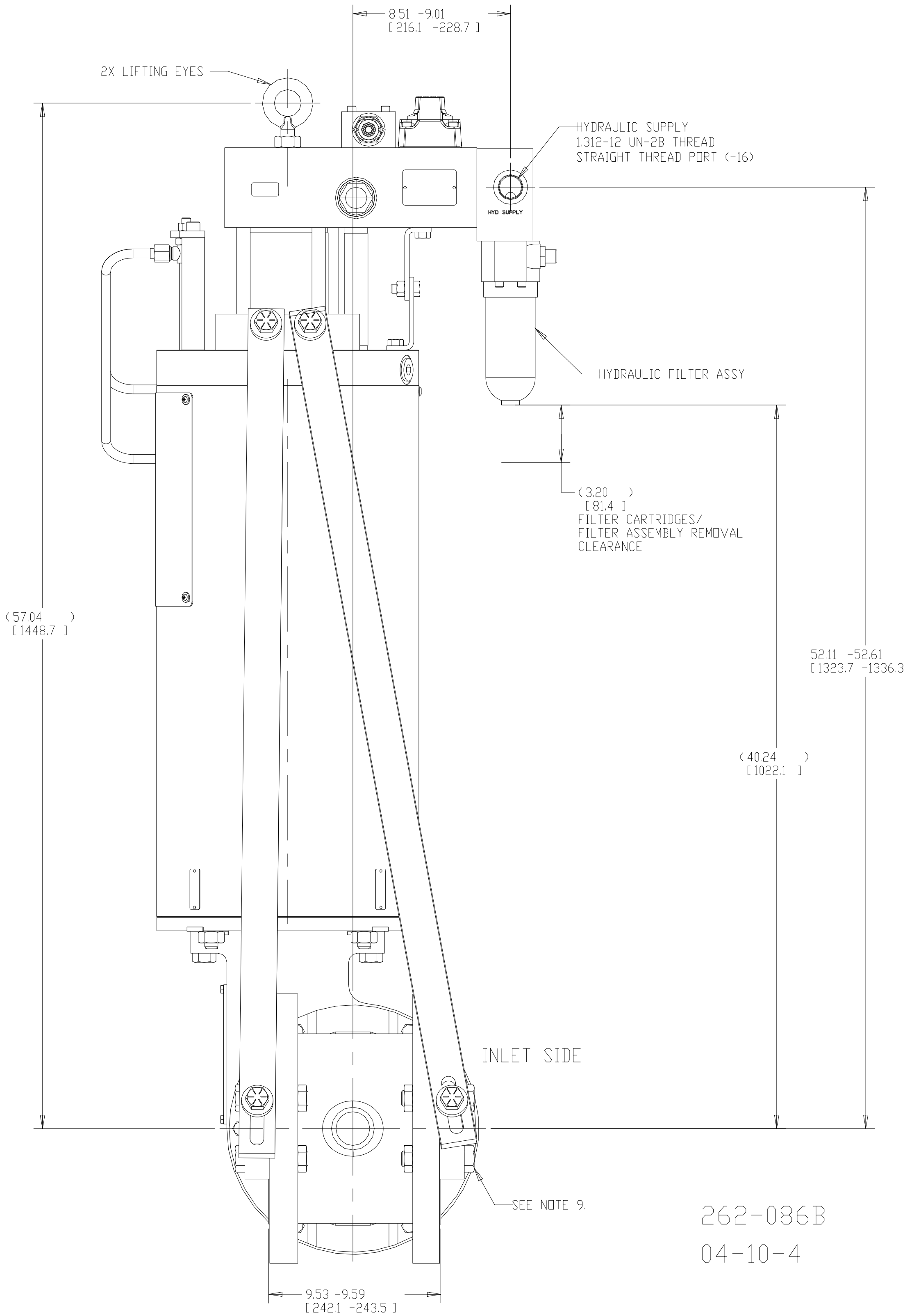


Figure 1-1b. 8-inch SS-260 Gas Stop/Ratio Valve Outline Drawing
(shown with high pressure trip valve)

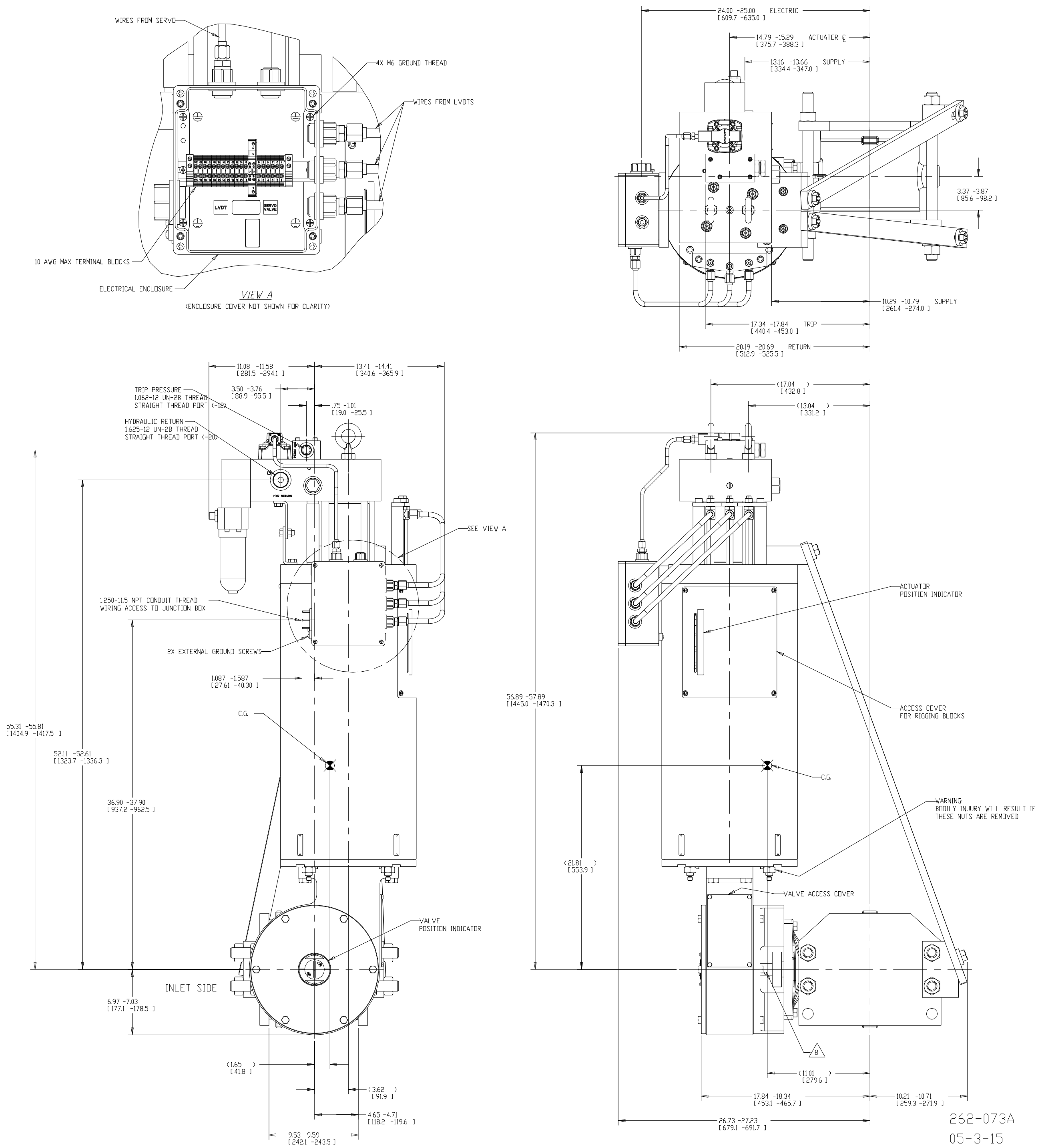


Figure 1-1c. 8-inch SS-260 Gas Stop/Ratio Valve Outline Drawing
(shown with low pressure trip valve)

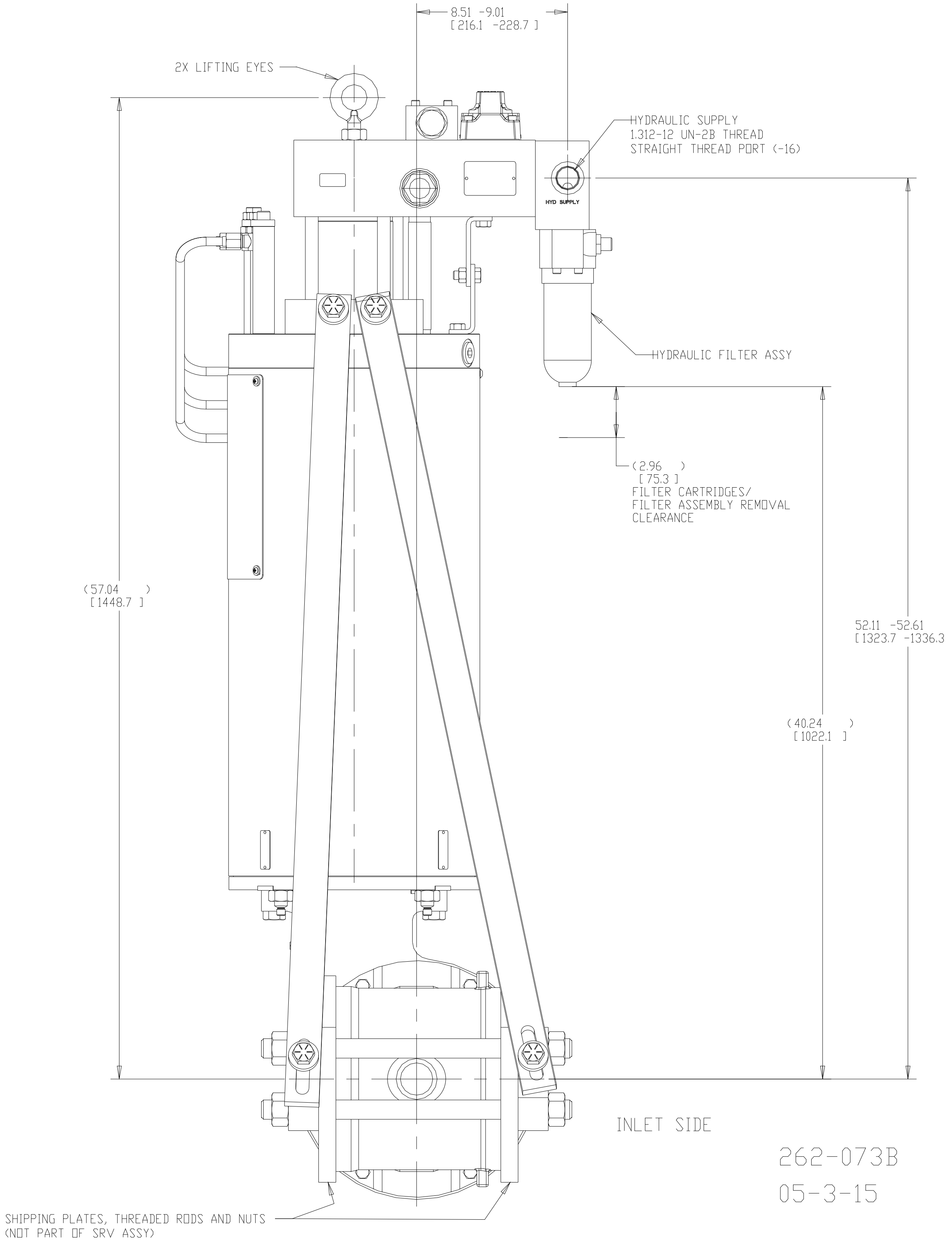


Figure 1-1d. 8-inch SS-260 Gas Stop/Ratio Valve Outline Drawing
(shown with low pressure trip valve)

Notes for Figure 1-1

1. Installation Orientation:
   a. Actuator must be oriented vertically, above pipe. Actuator and its support struts must be supported only by the fuel pipe flanges.

   Note: See elsewhere in this manual for other installation recommendations

2. Replacement Parts
   a. Servo valve—contact Woodward for the correct part number
   b. O-rings for servo valve—Woodward part number 1355-115 (4x) and 1355-107 (1x)
   c. Filter element—Woodward part number 1326-8002
   d. LVDT—Woodward part number 1886-7009
   e. Trip relay valve—Woodward part number 1309-045
   f. Seal kit for trip relay valve—Woodward part number 8928-368

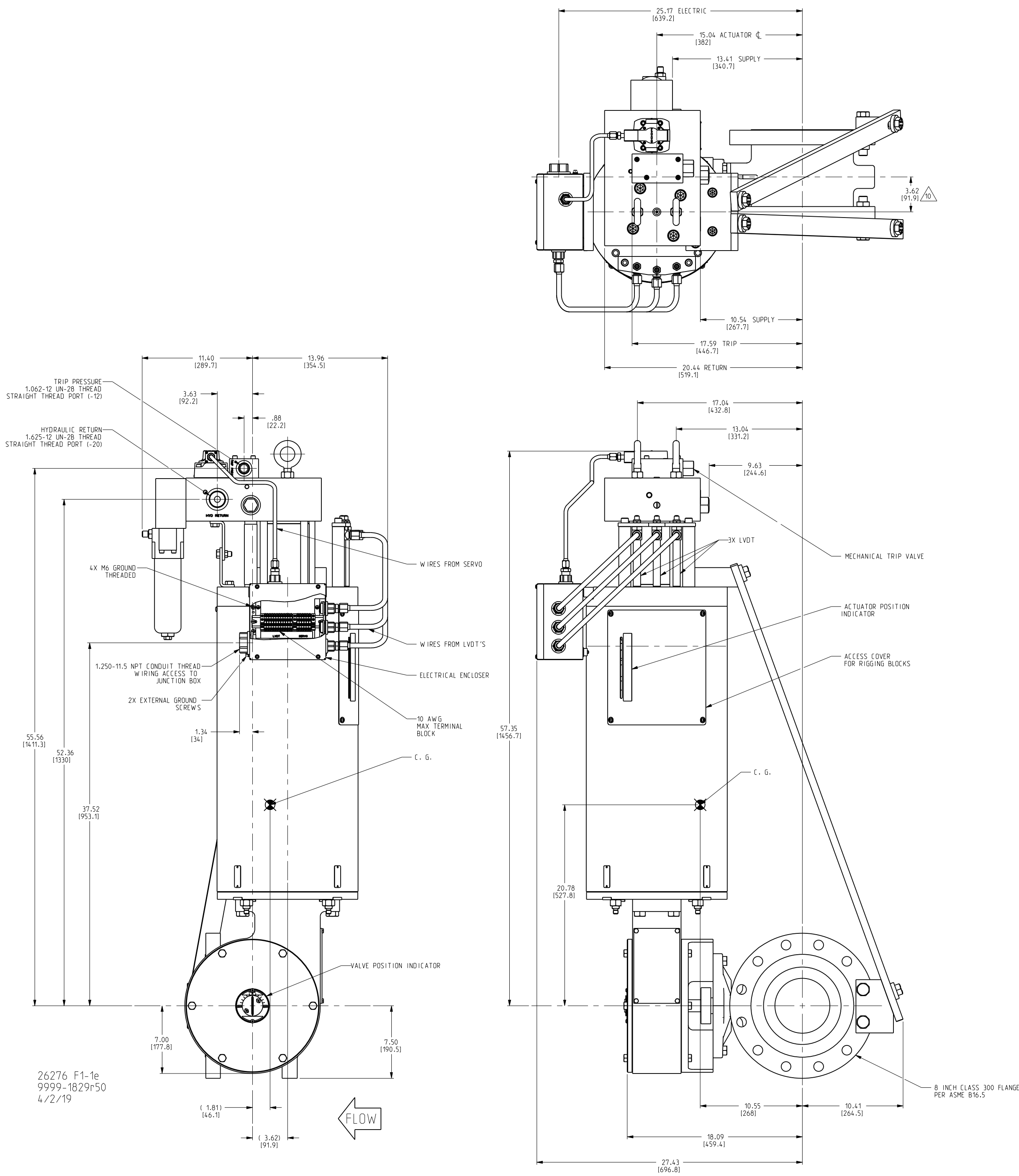


Figure 1-2a. 8-inch SS-260 Gas Stop/Ratio Valve with SST Junction Box Outline Drawing

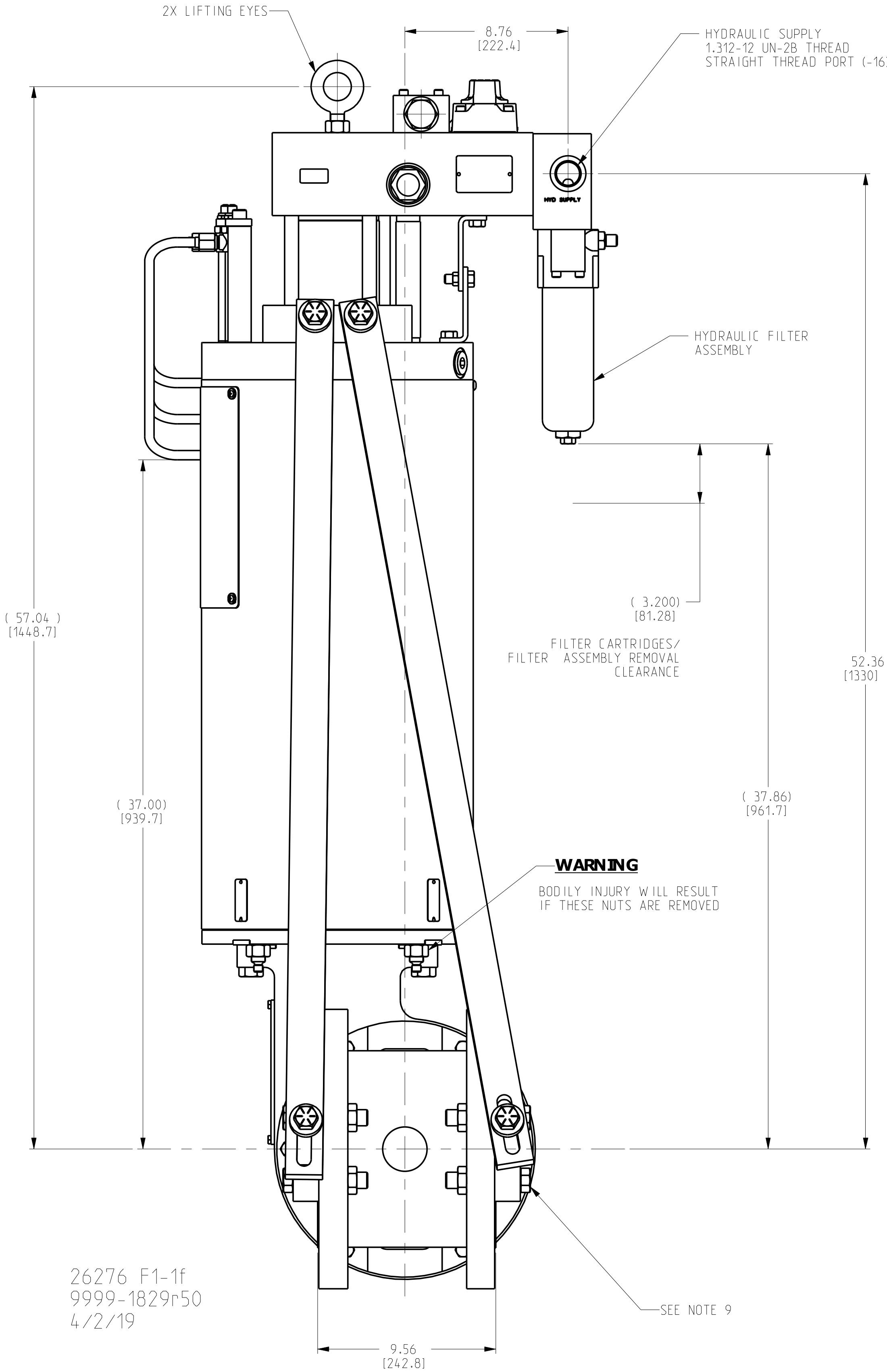


Figure 1-2b. 8-inch SS-260 Gas Stop/Ratio Valve with SST Junction Box Outline Drawing

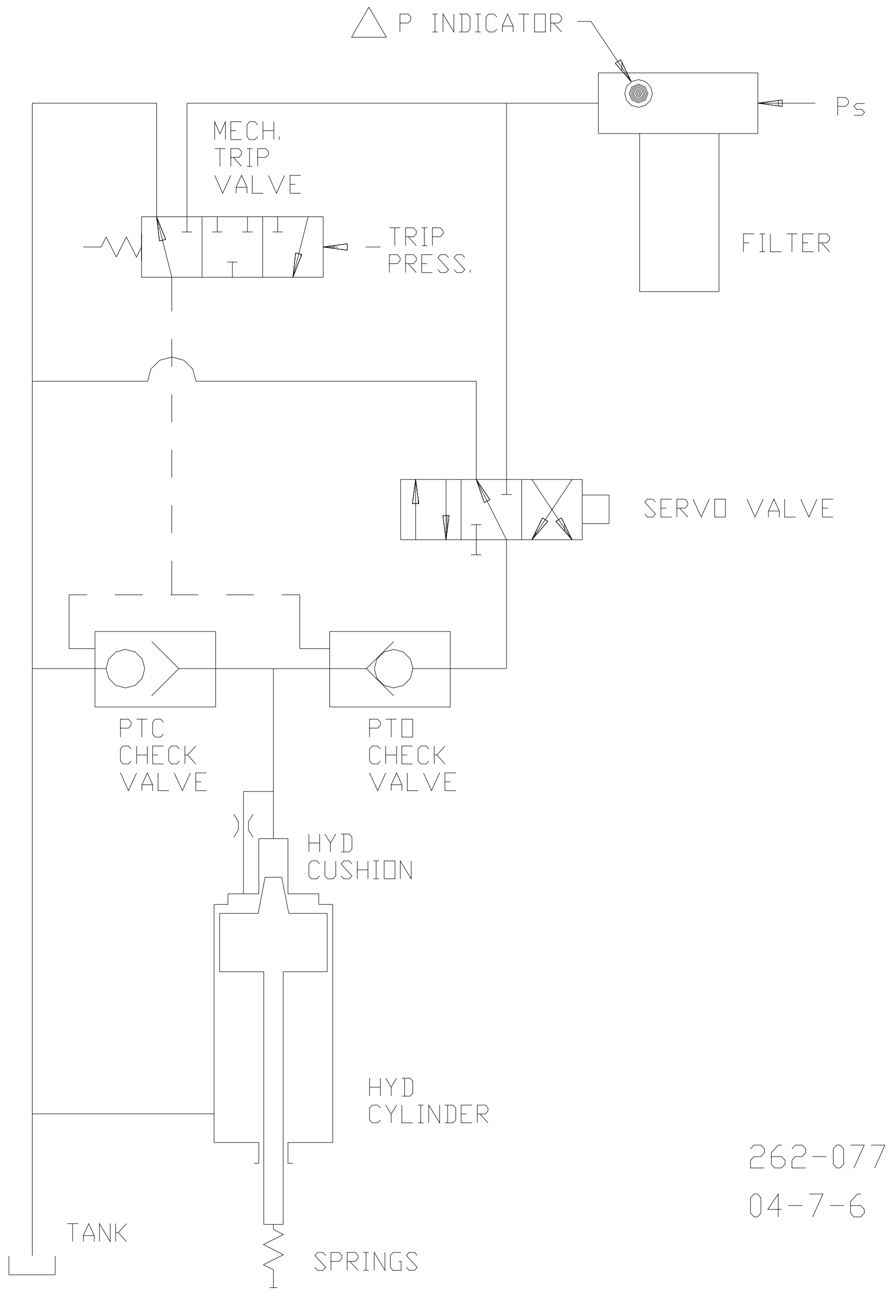


Figure 1-3. 8-inch SS-260 Gas Stop/Ratio Valve Hydraulic Schematic

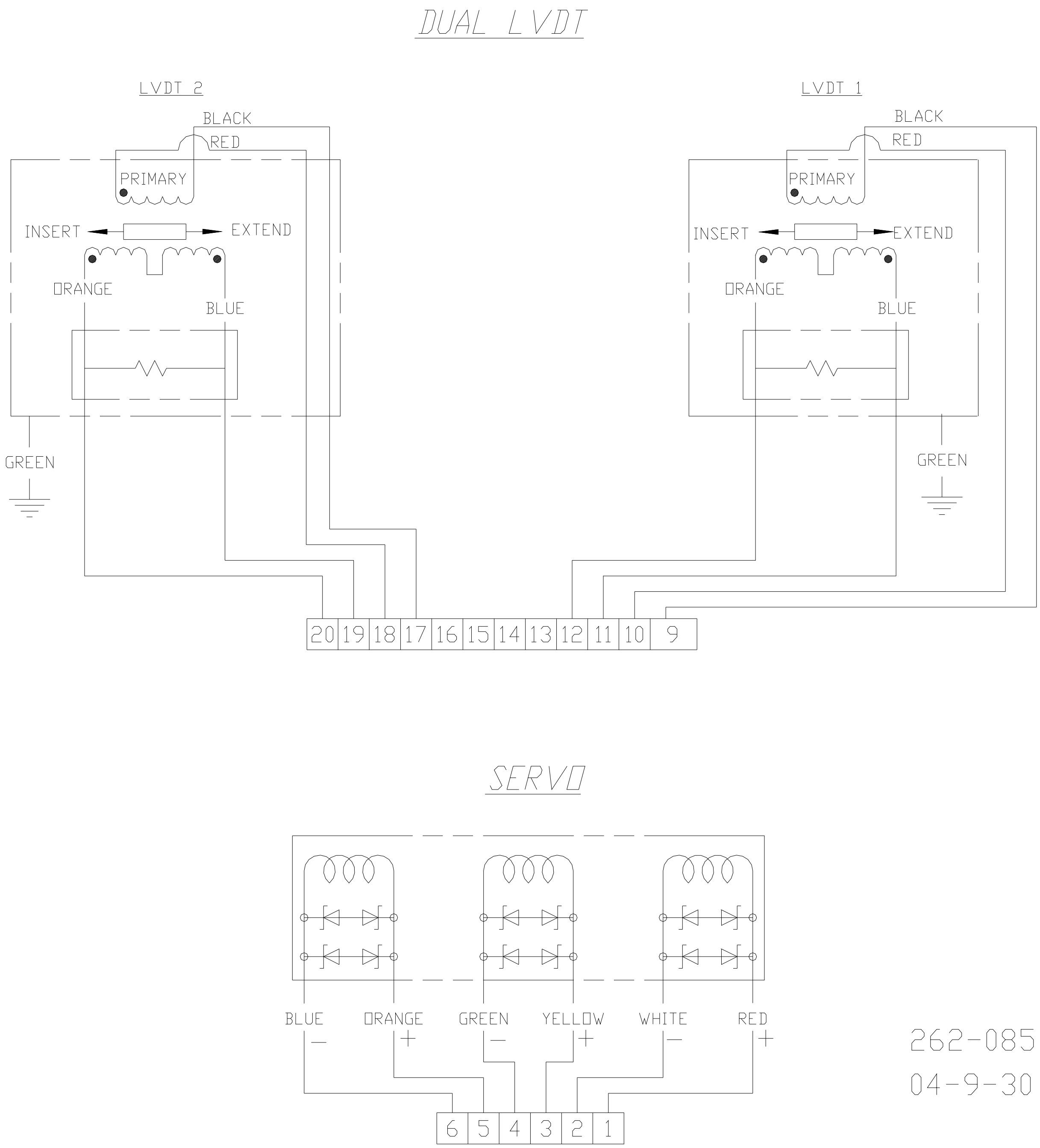


Figure 1-4a. 8-inch SS-260 Gas Stop/Ratio Valve Electrical Schematic and Wiring Diagram

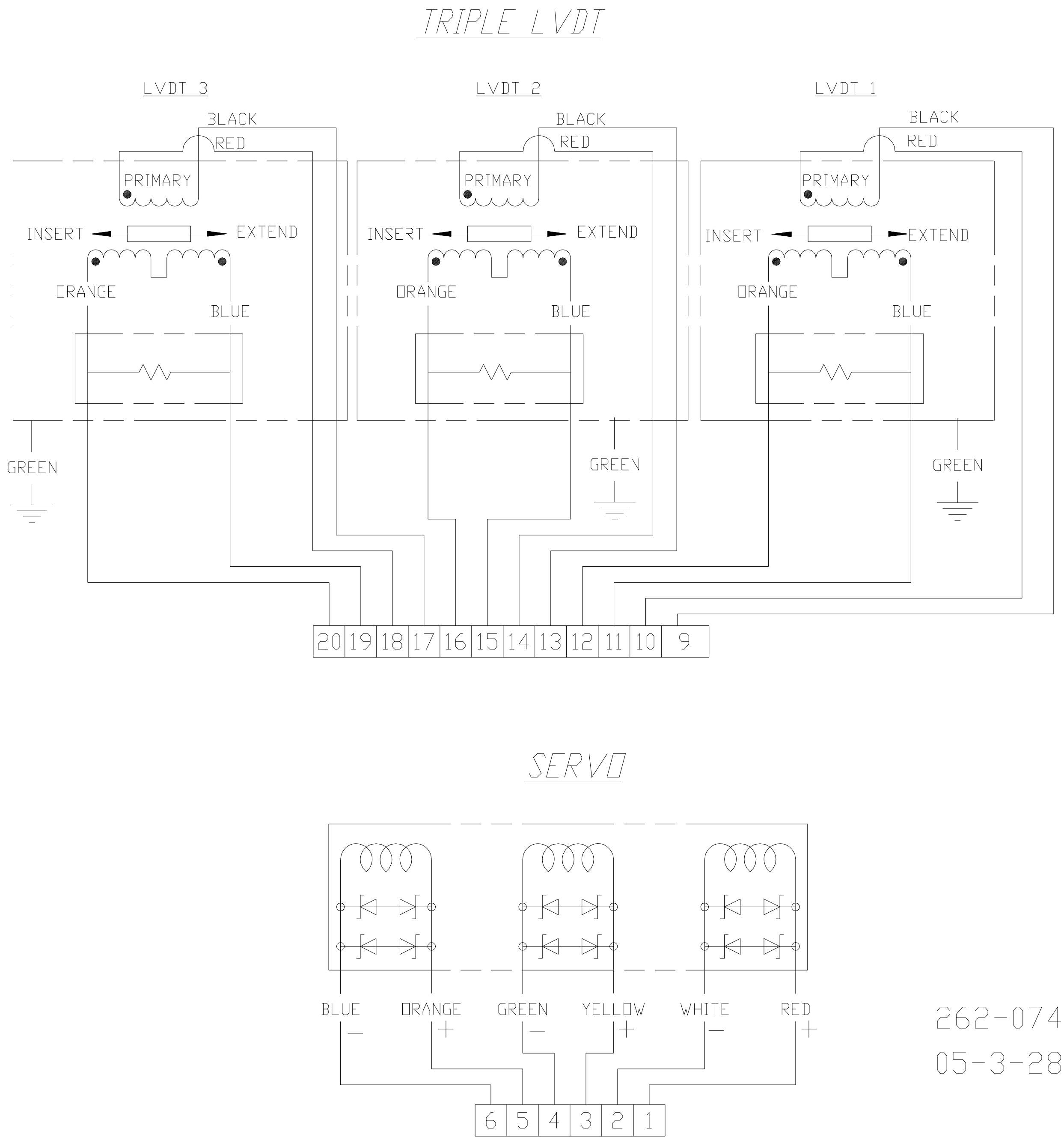
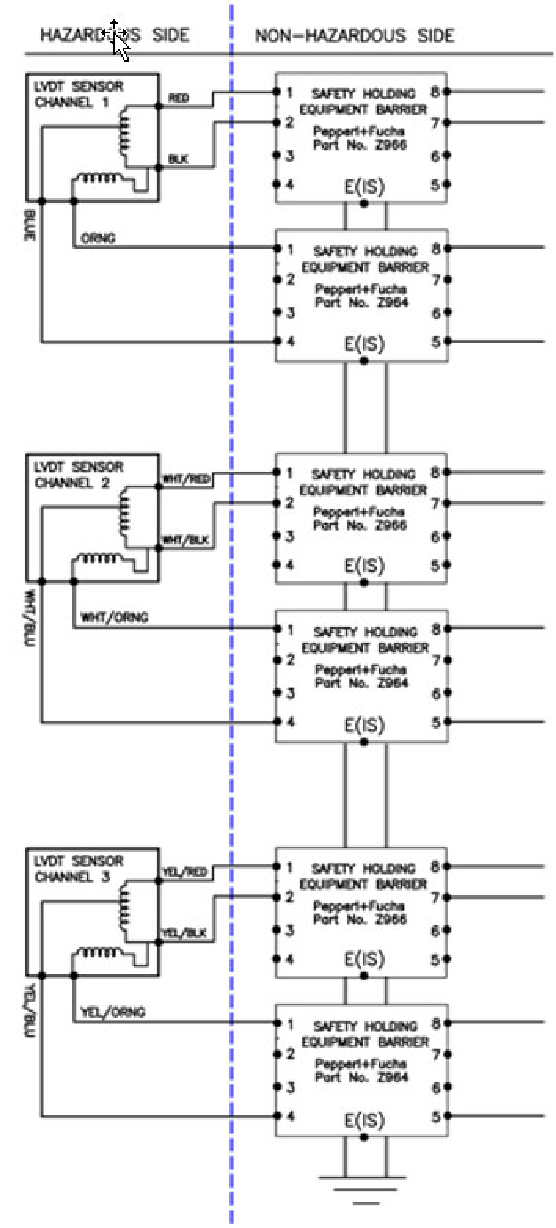


Figure 1-4b. 8-inch SS-260 Gas Stop/Ratio Valve Electrical Schematic and Wiring Diagram

LVDT Sensor is used as shown below:



NOTES:

1. All barriers must be mounted and installed in compliance with the barrier manufacturer's requirement.
   P+F barriers are by Pepperl+Fuchs GmbH
   A) Barrier board: Part No. Z966
      TIIS Certification No.: TC15714
      Certification to Pepperl+Fuchs GB Ltd. (Oldham, England)
      Performance Category and Group:
      Performance category: ia   Group: IIC
      Rating:
      Uo =12 V   Co =1.41μF
      Io =82 ma   Lo =5.52 mH
      Po =0.24 W
   B) Barrier board: Part No. Z964
      TIIS Certification No.: TC15713
      Certification to Pepperl+Fuchs GB Ltd. (Oldham, England)
      Performance Category and Group:
      Performance category: ia   Group: IIC
      Rating:
      Uo =12 V   Co =1.41μF
      Io =12 ma   Lo =240 mH
      Po =0.04 W
2. Inrinsic Safe parameters:
   Primary: Li=0.0 mH   Ci=0.0 μF
   Secondary: Li=2.50 mH   Ci=0.0 μF
3. Ambient Temperature: −20°C<=Tamb<=60°C.
4. E(IS) is the grounding terminal for holding the intrinsically safe explosion protection structure.
5. The outer wiring of each channel shall be carried out independently, for multiple channel unit. For single channel unit, this does not apply. For single channel unit, the second and third channels do not exist.
6. The input power source and voltages, etc. of the control system supplying the barriers shall not exceed AC 250 V, 50/60 Hz, DC 250 V at both Normal and abnormal conditions.
7. This drawing is for three channel LVDT. For two channel unit, ignore Channel 3. For Single Channel unit, ignore Channels 2 and 3.

Figure 1-5a. LVDT Barrier Wiring Diagram (TIIS requirement, Japan)
(This figure applies to TIIS requirement for Japan only)

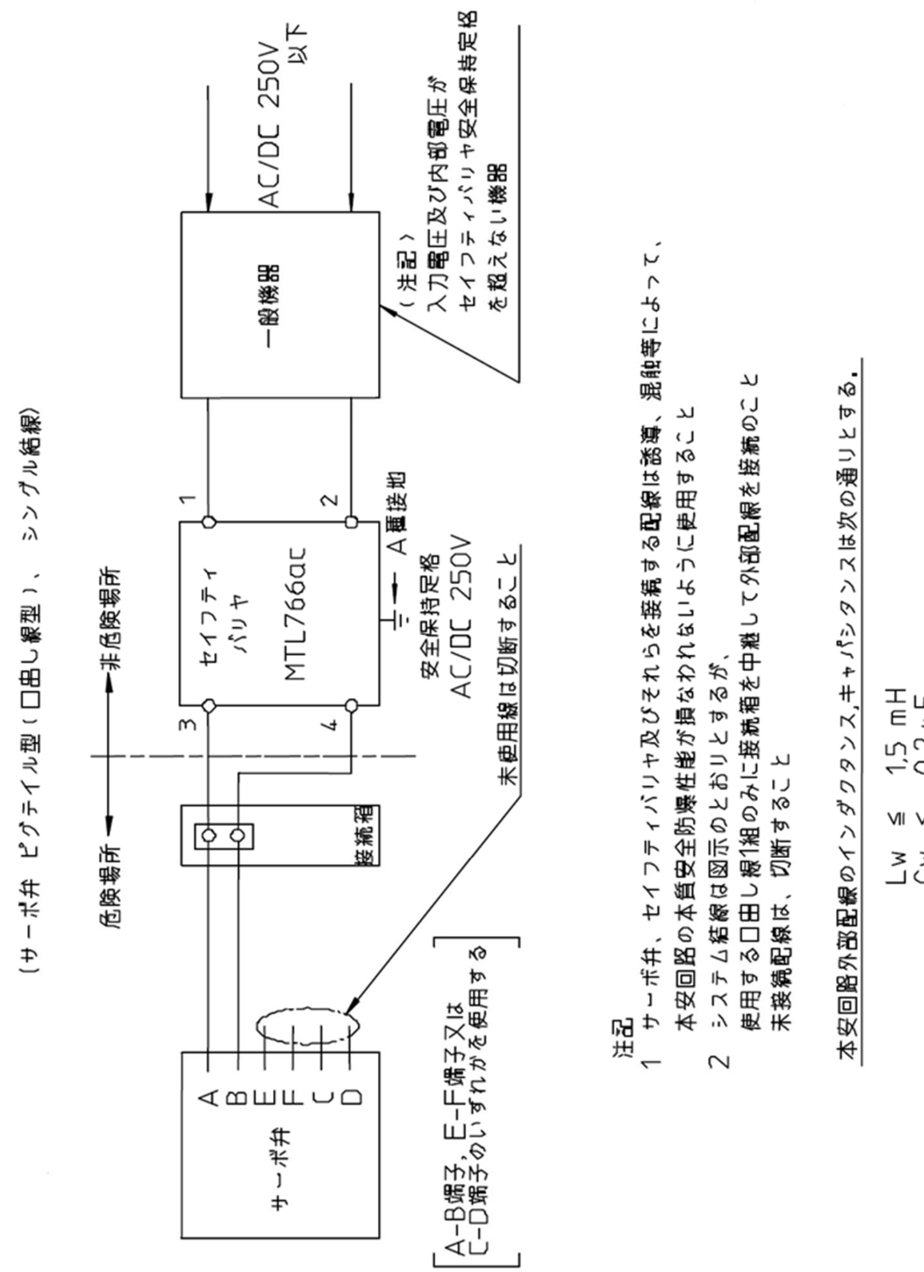


Figure 1-5b. Servo Valve Barrier Wiring Diagram (TIIS requirement, Japan)
(This figure applies to TIIS requirement for Japan only)

Chapter 2.
Stop/Ratio Valve Operation

The Gas Stop/Ratio Valve actuator is controlled by an electronic servo-control system (not included), which compares the commanded and actual valve positions. The control system modulates the input current signal to the electrohydraulic servo valve to minimize the positioning system error. See Figure 1-3 for a functional schematic of the single acting actuator.

Hydraulic oil enters the actuator via a removable element filter with integral high ΔP indicator and is directed to a four way, electrohydraulic servo valve used in a three-way configuration. The PC1 control pressure output from the servo valve is directed to the top of the hydraulic piston. When the force exerted by the hydraulic pressure exceeds the force of the opposing loading springs, the output piston extends, rotating the valve in the opening direction.

The trip relay circuit utilizes a trip relay valve and two logic valves to override the servo pressure that is normally directed to the top of the hydraulic piston. When trip pressure is lost, these valves act in concert to block the servo valve output and to dump the pressure above the hydraulic piston to drain. The actuator spring force then rapidly retracts the actuator, rotating the gas valve to the closed position.

Redundant LVDT position feedback transducers are also mounted within each actuator. The LVDT sensor cores and support rods are connected to the main actuator output rod by a guided coupling arrangement that maintains LVDT core/coil alignment.

Chapter 3.
Standard Component Details

Triple Coil Electrohydraulic Servo Valve Assembly

The stop/ratio valve actuator utilizes a two stage hydraulic servo valve to modulate the position of the output shaft and thereby control the stop ratio valve. The first stage torque motor utilizes a triple wound coil, which controls the position of the first and second stage valves in proportion to the total electrical current applied to the three coils.

If the control system requires a rapid movement of the valve to increase fuel pressure to the control valves, the total current is increased well above the null current. In such a condition, supply oil is admitted to the cavity above the actuator piston. The flow rate delivered to the upper piston cavity is proportional to the total current applied to the three coils. Thus, the actuator stroke velocity and the valve opening are also proportional to the current (above null) supplied to the torque motor above the null point.

If the control system requires a rapid movement to reduce fuel pressure downstream of the stop/ratio valve, the total current is reduced well below the null current. In such a condition, the actuator piston cavity is connected to the hydraulic drain circuit. The flow rate returning from the upper piston cavity of the valve is proportional to the magnitude of the total current below the null value. The flow rate and closing velocity of the valve are in this case proportional to the total current below the null point.

Near the null current, the servo valve essentially isolates the upper piston cavity from the hydraulic supply and drain, and the upper piston pressure and spring load are balanced 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 operation of the system.

Trip Relay Valve Assembly

The stop/ratio trip relay circuit utilizes a three-way, two position, hydraulically operated valve to override the commanded actuator position in response to a drop in trip pressure. The output of this trip relay valve controls two logic valves. A pilot-to-open (PTO) logic valve is interposed between the servo valve and the top of the hydraulic cylinder. A pilot-to-close (PTC) logic valve is interposed between the top of the hydraulic piston and drain. These logic valves, operated by the trip relay valve, provide the large flow area required for rapid actuator motion.

Both a low pressure trip valve and a high pressure trip valve are offered. These trip valves accommodate low pressure or high pressure trip circuits and operate as follows.

Low Pressure Trip Valve

When the externally supplied trip pressure is greater than 24 ±6 psid (165 ±41 kPa), relative to drain pressure, the PTO logic valves allow servo valve pressure to reach the top of the hydraulic piston and the PTC valve prevents loss of this pressure to drain. When trip pressure falls below 22 ±6 psid (152 ±41 kPa), relative to drain pressure, the trip relay valve shifts, causing the PTC and PTO valves to also shift. The PTO valve closes, blocking the servo valve outlet, and the PTC valve opens, dumping the hydraulic piston pressure to drain. The force supplied by the actuator return springs then pushes the actuator pushrod up, rotating the gas valve to the closed position, stopping fuel flow to the fuel metering system.

High Pressure Trip Valve

When the externally supplied trip pressure is greater than 750 ±100 psid (5171 ±690 kPa), relative to drain pressure, the PTO logic valves allow servo valve pressure to reach the top of the hydraulic piston and the PTC valve prevents loss of this pressure to drain. When trip pressure falls below 750 ±100 psid (5171 ±690 kPa), relative to drain pressure, the trip relay valve shifts, causing the PTC and PTO valves also to shift. The PTO valve closes, blocking the servo valve outlet, and the PTC valve opens, dumping the hydraulic piston pressure to drain. The force supplied by the actuator return springs then pushes the actuator pushrod up, rotating the gas valve to the closed position, stopping fuel flow to the fuel metering system.

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

Hydraulic Filter Assembly

The stop/ratio actuator is supplied with an integrated, high capacity filter. This 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 which indicates when the pressure differential exceeds the recommended value, indicating that replacement of the element is necessary.

LVDT Position Feedback Sensors

The stop/ratio actuator uses redundant LVDTs for position feedback. The flanged version uses dual LVDTs whereas the flangeless version uses triple LVDTs. The LVDTs are factory set to give 0.7 ±0.1 Vrms feedback at the valve-closed position and 3.5 ±0.5 Vrms feedback at the valve-open position. The actual voltage values for each LVDT are recorded on a label placed inside the actuator electrical box, for reference during field calibration.

Chapter 4.
Installation

General

See Chapter 1 and Figure 1-2 (outline drawing) for:
- Overall dimensions
- Process piping flange locations
- Hydraulic fitting sizes
- Electrical connections
- Lift points and center of gravity
- Weight of the valve

The design of the Vee-Ball® valve requires horizontally mounting the rotary drive shaft. Additionally, a vertical actuator 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 stop/ratio valve is designed for support by the piping flanges alone. Additional supports are neither needed nor recommended.

The standard stop/ratio valve is supplied with a left-hand orientation as shown in the outline drawing. The valve can be configured with a right-hand orientation; however, this request must be on the purchase order at the time the order is placed for this change to take place.

⚠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.**

NOTICE **Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".**

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

⚠WARNING **EXPLOSION HAZARD—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 temperature.**

⚠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 **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.

Verify that the process piping flange-to-flange-face dimensions meet the requirements of the outline drawing (Figure 1-2) 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.

The stop/ratio valve, with its integral strut supports, must be supported only by the pipe flanges. Additional supports are neither needed nor recommended.

NOTICE **The SS-260 stop/ratio valve is equipped with an integral strut support system to minimize possible overstressing of the Fisher SS-260 valve neck during shipping and handling, as well as during operation. Inertial forces generated by the trip action of the actuator, or by externally induced motion of the piping to which the stop ratio valve is attached, must be contained by the integral support system. If the integral support system is not properly installed during trip operation, overstressing of the Fisher SS-260 valve neck may occur.**

The stop/ratio valve is shipped with disposable shipping plates and four temporary studs to secure its strut support system during transport. This strut system must remain intact until the stop/ratio valve is readied for installation into the process piping. The strut support system reduces stresses incurred by the Fisher SS-260 valve neck and shaft during transit and operation.

Preparing the stop/ratio valve for installation requires the following procedure:

1. Suspend the stop/ratio valve assembly from the lifting hooks at its top.
2. Loosen the four ¾-16 strut attaching bolts.

NOTICE	**Do not rest the weight of the stop/ratio valve assembly on the Fisher valve once the strut supports system bolts are loosened.**

3. Remove and discard the four temporary flange studs and shipping plates.
4. Position the suspended stop/ratio valve assembly between the process piping flanges.
5. Position the lower strut brackets outboard of the process pipe flanges as shown in Figure 4-1.

IMPORTANT	**The mating faces of the struts and strut brackets must remain free of lubrication, paint, or other contaminants to assure adequate friction and proper strut function.**

Grade 5 (metric class 8.8) bolts or studs should be used to install the valve into the process piping.

For the flanged version, four 7 inch (177.8 mm) long threaded studs or bolts are required to secure the strut brackets. Standard length flange bolts are required in the remaining 8 flange bolt positions.

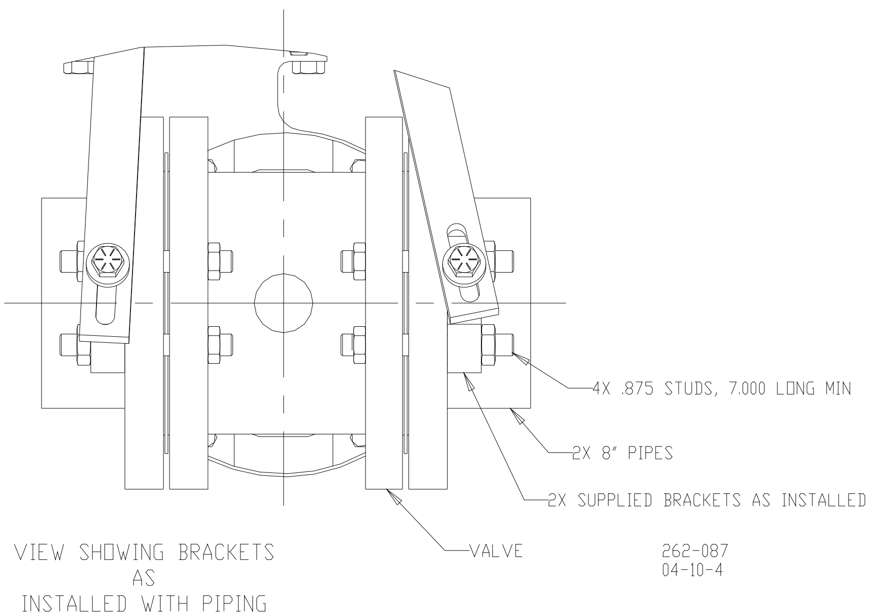


Figure 4-1a. Close-up of Strut Brackets on Pipe Flanges (Flanged Version)

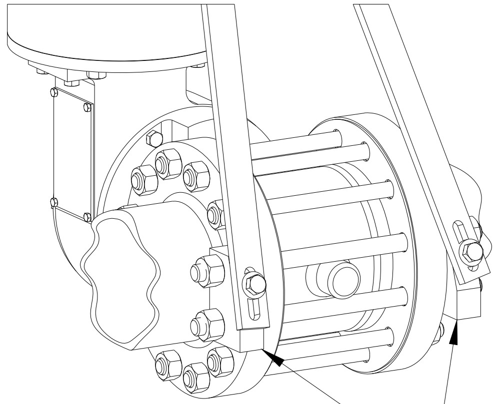


Figure 4-1b. Close-up of Strut Brackets on Pipe Flanges (Flangeless Version)

For the flangeless version, the threaded stud length and diameter for Class 600 flanges must conform to the following table according to the valve flange size.

Table 4-1. Stud Length and Diameter for Class 600 Flanges

Nominal Pipe Size	Number of Bolts	Diameter of Bolts	Stud Length
8-inch/203.2 mm	8	1.125 inch/28.6 mm	17 inch (min) /432 mm (min)
8-inch/203.2 mm	4	1.125 inch/28.6 mm	21 inch (min /533 mm (min)

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 value listed in the following table. Once all studs/bolts have been tightened to approximately that value, repeat the pattern until the rated torque value below is obtained.

Table 4-2. Bolt Size and Torque Ratings

Bolt Size	Rated Torque
1.125 inch (28.6 mm)	300-350 lb-ft (407–475 N•m)
0.875 inch (22.2 mm)	150–175 lb-ft (203–237 N•m)

6. Install the pipe flange gaskets, flange studs, and flange stud nuts, snugging all flange nuts, but not tightening them at this time.
7. Partially tighten the four 0.750–16 strut attachment bolts enough to assure alignment of the strut and the strut bracket faces. Do not fully tighten at this time.
8. Tighten the piping flange studs per torque values above.
9. Tighten the four 0.750–16 strut attachment bolts to 280–300 lb-ft (380–407 N•m).

Hydraulic Connections

There are three hydraulic connections that must be made to each valve: supply, return, and trip oil. The connections to the valve are straight-thread O-ring style ports per SAE J514. 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 is to be 1.000 inch (25.40 mm) tubing.

The hydraulic drain should be 1.25 inch (31.8 mm) tubing and must not restrict the flow of fluid from the valve. The drain pressure must not exceed 30 psig (207 kPa) under any condition.

The trip relay valve supply should be 0.750 inch (19.05 mm) tubing. The Trip Relay Pressure, under normal operating conditions, should be at least 40 psi (276 kPa) above drain pressure.

Electrical Connections

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

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

⚠WARNING	**Protective earth (PE) ground must be connected on the junction box per the installation drawing to reduce the risk of electrostatic discharge in an explosive atmosphere.**

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 recommended. All signal lines should be shielded to prevent picking up stray signals from nearby equipment. Installations with severe electromagnetic interference (EMI) may require shielded cable run in conduit, double-shielded wire, or other precautions. Connect the shields at the control system side or as indicated by the control system wiring practices, but never at both ends of the shield such that a ground loop is created. Wires exposed beyond the shield must be less than 2 inches (51 mm). The wiring should provide signal attenuation to greater than 60 dB.

Servo Valve Electrical Connection

Servo valve cable must consist of three individually shielded twisted pairs. Each pair should be connected to one coil of the servo valve as indicated in Figure 1-4 (Wiring Diagram).

⚠WARNING	**For valves with TIIS requirements (in Japan), the servo valve wiring must be installed with barriers, as shown in Figure 1-5b as required for use with the intrinsically safe method of protection.**

LVDT Electrical Connection

For flanged versions, the LVDT cable must consist of four individually shielded twisted pairs. For flangeless versions, the LVDT cable must consist of six individually shielded twisted pairs. Separate pairs should be used for each of the excitation voltages to the LVDT, and separate pairs should be used for each of the feedback voltages from the LVDT.

⚠WARNING	**For valves with TIIS requirements (in Japan), the LVDT wiring must be installed with barriers, as shown in Figure 1-5a as required for use with the intrinsically safe method of protection.**

Fuel Vent Port

The fuel vent port, located on the SS-260 valve shaft packing assembly, must be vented to a safe location. In normal operation, this vent should have zero leakage. However, if excessive leakage is detected from this vent port, contact a Woodward representative for assistance.

Electronic Settings

Dynamic Tuning Parameters

It is imperative that the correct dynamic characteristics of this valve be input into the control system to ensure that the operation of the valve/control system is within acceptable limits.

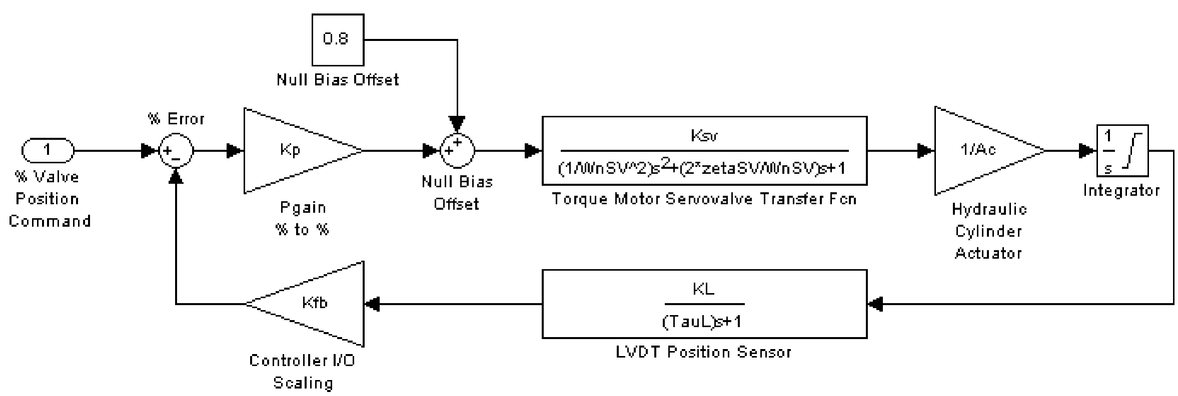


Figure 4-2. Stop/Ratio Valve Block Diagram

Notes for Figure 4-2.

Ksv nominal =	8.1 in^3/sec/mA at 1600 psi supply (valve opening); 14.8 in^3/sec/mA at 1600 psi supply (valve closing); Ksv is proportional to square root of supply, and constant with position.
ZetaSV =	0.8
WnSV =	126 rad/s (20 Hz); WnSV is proportional to square root of supply
Ac =	9.62 in^2
KL =	0.467 Vrms/inch
Servo Travel =	6.0 inches
TauL =	0.005 seconds (typical, depends on excitation/demodulation)

Null Current Adjustment

Every valve shipped contains documentation that gives the actual Null Current as measured by Woodward. 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.

Rigging Procedure

Inside the electrical enclosure of the valve, there is an adhesive label that contains the appropriate valve position (as a percent of full stroke), the physical stroke (inches), and the corresponding LVDT feedback signals for each LVDT (assuming 7.0 Vrms excitation at 3000 Hz).

Once the control system is connected to the valve and control of the valve is established, set the valve command position to 0% of full stroke. Measure the feedback voltage from each LVDT. Adjust the Offset in the feedback loop until the feedback voltage matches the documented values (see the label inside the electrical enclosure) for that position. Adjust the command position to 100% of full stroke. Adjust the Gain of the feedback loop until the LVDT feedback voltage matches the documented values. Set the command position to close the valve. Verify that the valve is closed visually and that the feedback voltage from the LVDT is 0.7 ± 0.1 Vrms. This process may have to be repeated to ensure the feedback voltages at both the 0% and 100% command positions match the documented values.

Chapter 5.
Maintenance and Hardware Replacement

Maintenance

⚠WARNING **Any cleaning by hand or with water spray must be performed while the area is known to be non-hazardous to prevent an electrostatic discharge in an explosive atmosphere.**

The Gas Stop/Ratio Valve requires no maintenance or adjustment in preparation for or during normal 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.

In the event that any of the standard components of the valve become inoperative, field replacement of certain components is possible. Contact a Woodward representative for assistance.

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 **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.

⚠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 Stop/Ratio 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 **Do not lift or handle the valve by any conduit. Lift or handle the valve only by using the eyebolts.**

See outline drawing (Figure 1-2) for the location of items.

Safety Block

(Example, Woodward part number 3621-1091)
This part is used to mechanically block the actuator so that it cannot move during service.

⚠WARNING **Use care and follow all instructions after removal of the spring access cover. Internal components can potentially crush fingers, and some components are held under significant force.**

Inserting Safety Block:

1. Remove the access cover from the side of the stop/ratio actuator housing by removing the four #10-32 UNF screws and washers.
2. Apply hydraulic pressure to the stop/ratio actuator and manually manipulate the actuator electronic control to cause the actuator to stroke 75% to 100%.
3. Carefully insert the safety block through the access opening as shown in Figure 5-1, straddling the middle LVDT if applicable and the piston rod as shown. The safety block is provided with the stop/ratio valve. It is an aluminum weldment having dimensions of approximately 6 inches tall by 3 inches wide by 8 inches long (152 mm x 76 mm x 203 mm). The safety block should be oriented with the opening towards the piston rod and the 6 inch dimension parallel to the piston rod shaft, with the piston rod and middle LVDT (if applicable) centered between the 6-inch tall sides, fully inserted as shown. Its purpose is to prevent accidental movement of the actuator while the actuator is being serviced.
4. Manipulate the actuator control to command a fully closed stop/ratio valve position. This will result in the stop/ratio actuator piston resting on the safety block in about the 95% stroke position. In this position, the lower linkage bolt that connects the actuator and the Fisher gas valve becomes readily accessible.
5. Hydraulic pressure and electrical connections can now be removed, and the actuator will not move.

Removing Safety Block:

1. Hook up electrical connections and hydraulic pressure to actuator.
2. Apply hydraulic pressure to the stop/ratio actuator, and manually manipulate the actuator electronic control to cause the actuator to stroke 75% to 100%.
3. Carefully remove the safety block from the access opening as shown in Figure 5-1.
4. Reinstall the access cover on the side of the stop/ratio actuator housing. Torque screws to 34 ± 4 lb-in (3.8 ± 0.5 N•m).

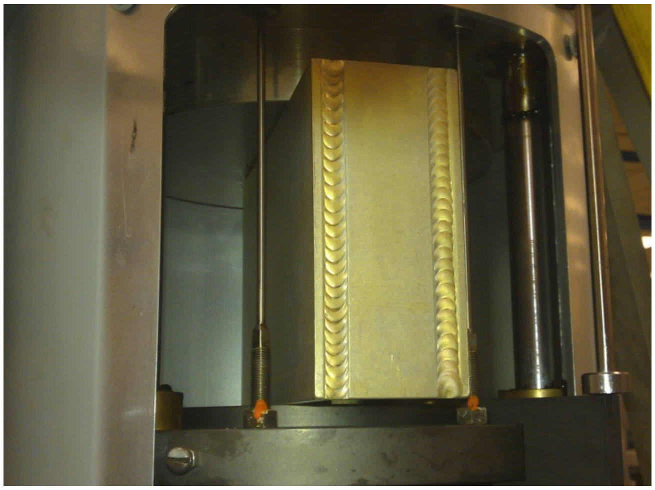


Figure 5-1. Safety Block

Hydraulic Filter Assembly/Cartridge

The hydraulic filter is located on the hydraulic manifold, hanging directly under the servo valve.

Replacement of Filter Assembly

1. Remove four 0.312-18 UNC socket head cap screws.
2. Remove the filter assembly from manifold block.

IMPORTANT	The filter contains a large amount of hydraulic fluid that may be spilled during filter removal.

3. Remove the two O-rings present in the interface between the filter and the manifold.
4. Obtain a new filter assembly.
5. Place two new O-rings in the new filter assembly.
6. Install filter onto manifold assembly. Be sure to place the filter in the correct orientation. See the outline drawings (Figure 1-2).
7. Install four 0.312-18 cap screws through filter and torque into manifold to 160–200 lb-in (18.1–22.6 N•m).

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

Replacement of Filter Cartridge

IMPORTANT	The filter contains a large amount of hydraulic fluid that may be spilled during filter removal.

1. Using a 1-5/16 inch (~33+ mm) wrench, loosen the bowl from the filter assembly.
2. Remove the filter element by pulling it downward.
3. Obtain a new filter element.
4. Lubricate the O-ring on the ID of the cartridge with hydraulic fluid.
5. Install the cartridge into the assembly by sliding the open end of the cartridge upward onto the nipple.
6. Install the filter bowl. Tighten only by hand.

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

Trip Relay Valve Cartridge

The trip relay valve cartridge is located in an adaptor block mounted on top of the hydraulic manifold block.

IMPORTANT

Hydraulic fluid may spill during cartridge removal.

1. Using a 1.5-inch (~38+ mm) wrench, loosen the trip relay valve from the hydraulic manifold.
2. Slowly remove the cartridge from the manifold.
3. Obtain new trip relay valve cartridge and verify part number and revision with existing unit.
4. Verify that all O-rings and backup rings are present on new cartridge.
5. Lubricate O-rings with hydraulic fluid or petroleum jelly.
6. Install cartridge into manifold housing.
7. Torque to 80–90 lb-ft (108–122 N•m).

Servo Valve

The servo valve is located on the top of the hydraulic manifold directly above the filter assembly. Refer to the outline drawings (Figure 1-2).

IMPORTANT

There could be a substantial amount of hydraulic fluid upon removal.

1. Remove the cover to the electrical junction box.
2. Disconnect the servo valve wires from the connector blocks labeled 1–6.
3. Loosen the conduit fittings from the electrical box and the servo valve.
4. Carefully remove the conduit from the servo valve and pull the wiring out of the conduit.
5. Remove the four 0.312-18 UNC socket head cap screws holding the servo valve to the manifold.
6. Discard the eight O-rings between the servo valve, the adapter plate, and the manifold.
7. Obtain replacement servo valve and verify part number and revision with existing unit.
8. Place four new O-rings on the adapter plate.
9. Reposition adapter plate onto hydraulic manifold ensuring hydraulic passages and bolt holes are aligned correctly. Be sure that all four O-rings remain in their proper location during assembly on the lower side of the adaptor plate facing the manifold.
10. Remove protective plate from replacement servo valve and verify that O-rings are on all four counter bores of the servo valve.

11. Place the servo valve onto the adapter plate that has been positioned on the hydraulic manifold. Be sure to orient the servo valve to match the original orientation. Be sure that all four O-rings remain in their proper location during assembly.
12. Install four 0.312-18 UNC socket head cap screws and torque to 108–132 lb-in (12.2–14.9 N•m).
13. Install the servo valve wiring through conduit and into electrical box.
14. Connect conduit to servo valve and torque to 100–125 lb-in (11–14 N•m).
15. Torque conduit to electrical box to 100–125 lb-in (11–14 N•m).
16. Install wires into servo valve connector blocks labeled 1–6 as shown in the wiring diagram (Figure 1-4). If it is necessary to cut wires for installation, be sure to retain at least one service loop of wiring.
17. Replace cover onto junction box and tighten screws.

LVDT Replacement

⚠WARNING	**To prevent possible personal injury, do NOT remove the spring cover (which is spring-loaded to over 4000 lb/17760 N). The four 0.750-16 UNF spring cover attaching nuts have metal tab locks and should not be disturbed.**

The LVDTs are located on the upper mounting plate located on the top of the large spring cylinder and below the hydraulic manifold. Refer to the outline drawings (Figure 1-2).

1. Remove the cover to the electrical junction box.
2. Disconnect the wires of the defective LVDT from the connector blocks.
3. Loosen the conduit fittings from the electrical box and from the defective LVDT.
4. Carefully remove the conduit from the defective LVDT and pull the LVDT wiring out of the conduit.
5. Remove the 0.500-20 UNF mounting nuts from all three LVDTs.
6. Remove the two 0.500-13 UNC socket head cap screws holding the LVDT bracket to the upper mounting plate.
7. Remove the LVDT mounting plate by lifting vertically upwards.
8. Remove the four #10-32 UNF screws holding the access cover on the side of the spring cylinder to gain access to the LVDT core rods.
9. Loosen the 0.375-24 UNF jam nut on the defective LVDT core rod.
10. Remove the defective LVDT rod using the 0.250 inch flats at the top of the threads. The rod will be difficult to unscrew due to the thread-locking feature incorporated into the spring plate.
11. Obtain replacement LVDT and verify part number and revision with existing unit.
12. Install the 0.375-24 UNF jam nut onto the replacement LVDT core rod.
13. Install replacement LVDT rod into spring plate, positioning the rod height to approximately match the other LVDT rod heights. Do not tighten the jam nut at this time.
14. Carefully slide replacement LVDT through upper mounting plate and over the LVDT rod. Be careful to not force the LVDT at any time since this could damage the LVDT rod.
15. Replace the LVDT mounting plate over the three LVDTs.
16. Install the two 0.500-13 UNC socket head cap screws holding the LVDT bracket to the upper mounting plate and torque to 60–70 lb-ft (81.3–95 N•m).
17. Install the 0.500-20 UNF mounting nuts on all three LVDTs and torque the mounting nuts to 400–500 lb-in (45–56 N•m).
18. Install replaced LVDT wiring through conduit and into electrical box.
19. Connect conduit to LVDT and torque to 450–550 lb-in (51–62 N•m).
20. Torque conduit to electrical box to 450–550 lb-in (51–62 N•m).
21. Install wires into LVDT connector blocks as shown in the wiring diagram (Figure 1-4). If it is necessary to cut wires for installation, be sure to retain at least one service loop of wiring.
22. Once the LVDT is installed, it must then be calibrated as described below.

LVDT Calibration

1. Whenever an LVDT is replaced, or whenever its core rod adjustment is disturbed, the LVDT output voltage must be calibrated in the following way.

⚠WARNING **Use care and follow all instructions after removal of the spring access cover. Internal components can potentially crush fingers, and some components are held under significant force.**

2. Shut off the hydraulic supply to the stop/ratio actuator.
3. Remove the access cover from the side of the stop/ratio actuator housing by removing the four #10-32 UNF screws and washers, exposing the LVDT core rod adjustment.
4. Loosen the LVDT core rod jam nut and adjust the LVDT rod so that the output of the replaced LVDT is 0.7 ± 0.1 Vrms with the stop/ratio actuator fully retracted (gas valve fully closed).
5. Tighten the 0.375-24 UNF LVDT rod jam nut to 270–320 lb-in (31–36 N•m).
6. Confirm that the LVDT output remains 0.7 ±0.1 Vrms. Readjust if required.
7. Install the stroke measurement attachment bar (Woodward part number 3780-1034 provided with the stop/ratio actuator) to the moving plate of the actuator as shown in Figure 5-2.
8. Attach an accurate stroke measurement device (dial indicator or equivalent), capable of measuring 6 inches (152 mm) of stroke, to the stop/ratio actuator body. Position the indicator plunger tip on the measurement bar, as shown in Figure 5-2.
9. Apply hydraulic pressure to the stop/ratio actuator and manually command the actuator to stroke 6.000 ±0.010 inches (152.4 ±0.25 mm) by manipulating the electronic controller.
10. Note and record the LVDT output voltages at this 6.000 inches stroke position.
11. Remove the actuator control command, returning the actuator to its rest (gas valve closed) position.
12. Shut off the stop/ratio actuator hydraulic supply.
13. Update the stop/ratio control logic with the new LVDT output voltage value.
14. Remove the cover on the stop/ratio actuator electrical junction box.
15. Replace the original LVDT max output voltage value on the label in the stop/ratio actuator electrical junction box with the newly measured value.
16. Replace the cover on the junction box and tighten the screws.
17. Remove the dial indicator and measurement bar.
18. Reinstall the access cover with four #10-32 UNF screws, adjusting the closed indicator mark to align with the position indicator screw slot. Tighten the four cover attaching screws to 30–40 lb-in (3.4–4.5 N•m).

Figure 5-2. Stroke Measurement Attachment Bar

Separating the Stop/Ratio Actuator & Transfer Case Assembly from the Fisher Gas Valve

⚠WARNING	**To prevent possible personal injury, do NOT remove the spring cover (which is spring-loaded to over 4000 lb/17 760 N). The four 0.750-16 UNF spring cover attaching nuts have metal tab locks and should not be disturbed.**

1. Shut off the stop/ratio actuator hydraulic pressure.
2. Remove the linkage access cover and end plate assembly from the actuator transfer case. It is not necessary to remove the shaft position indicator or hub from the end plate.
3. Remove the actuator pushrod linkage cross bolt.
4. Loosen the clamp bolt on the actuator lever. Remove the lever.
5. Provide means to support the Fisher gas valve and to support and lift the stop/ratio actuator and transfer case assembly.
6. Remove the four 0.625-11 UNC bolts that attach the Fisher gas valve to the stop/ratio actuator transfer case.
7. Separate the transfer case and Fisher gas valve.

Joining the Actuator/Transfer Case Assembly to the Gas Valve

1. Remove the linkage access cover and end plate from the actuator transfer case.
2. Remove the lower rod end and its jam nut from the actuator pushrod.
3. Remove the turnbuckle from the actuator pushrod. Leave its jam nut on the pushrod.
4. Supporting both the actuator and the Fisher gas valve, join the actuator and valve, carefully guiding the valve shaft through the transfer case bearing.
5. Install the four 0.625-11 UNC bolts that secure the gas valve to the actuator. Tighten the bolts to 130–150 lb-ft (476–203 N•m)
6. Temporarily place the lever onto the valve shaft, oriented approximately as shown in Figure 5-3.
7. Pre-rig the valve by rotating the lever as required. A pry bar inserted through the transfer case inspection window can be used to move the lever.
8. Pre-adjust the Fisher gas valve per the Fisher SS_260 Vee-ball Instruction Manual (Form 5290; SS-260 errata sheet, Oct 2004 or later):
   - Make sure the valve is closed.
   - Insert a screwdriver or pry bar between the outboard ear of the ball and the valve body.
   - Pry the ball tightly against the thrust washer and the bearing on the actuator side of the valve.
   - Pre-position the Fisher gas valve in the fully closed position, as directed, setting the minimum gap between the valve seal and the seal protector ring is 0.010–0.020 inch (0.25–0.51 mm).

NOTICE

Refer to the Fisher Vee-Ball® Valve manual for instruction in preventing damage to the valve seal by closing the ball too far.

9. Remove the lever, if necessary, and reinstall it, engaging the lever and shaft spline teeth so as to achieve the closest possible alignment of the index marks on the lever face and the transfer case (see Figure 5-3). The lever index mark should be no more than 1.00 inch (25.4 mm) above (CCW from) the transfer case index mark and should be more than 0.50 inch (12.7 mm) below (CW from) the case index mark.

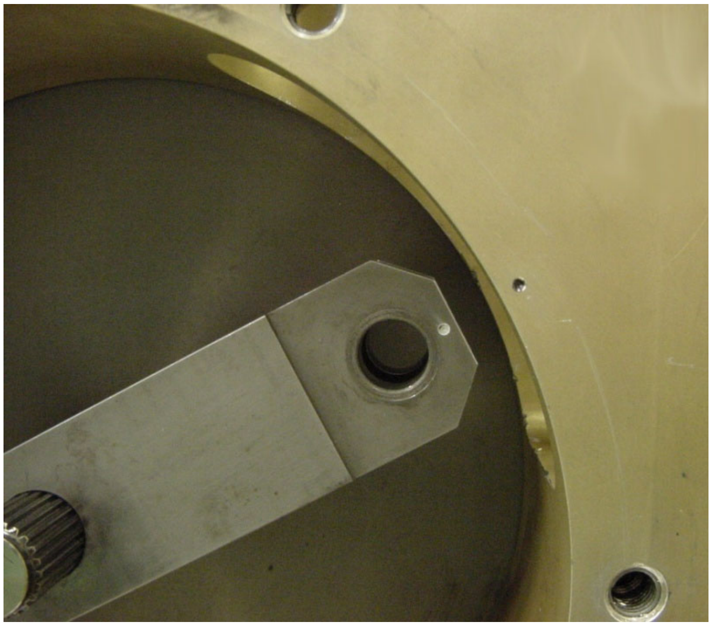


Figure 5-3. Alignment of Index Marks

10. Push the lever onto the shaft so that it contacts, or nearly contacts, the bronze shaft bearing in the back of the actuator transfer case.
11. Install the lever clamp bolt, and lock nut. Push the lever inward so that it contacts the rear bearing and tighten the lever clamp bolt. Tighten the lever clamp bolt to 50–70 lb-ft (68–95 N•m).
12. Rotate the lever CW (opening valve direction) to clear the pushrod linkage.

WARNING **Do not allow the Vee-Ball Valve to rotate much beyond its fully closed position in the closing direction.**

13. Preset the jam nut on the pushrod so that 1.00 ±0.03 inch (25.4 ±0.8 mm) of thread is exposed between the jam nut and the end of the pushrod.
14. Install the turnbuckle on the pushrod so that the turnbuckle contacts the jam nut. Do not yet tighten the nut.
15. Pre-set the jam nut on the lower rod end so that 1.00 ±0.03 inch (25.4 ±0.8 mm) of thread is exposed between the jam nut and the end of the rod end.
16. While keeping the turnbuckle from turning, install the lower rod end into the turnbuckle until its preset jam nut contacts the turnbuckle. Do not yet tighten the jam nut.
17. With minimal rotation of the lower rod end, align the lower rod end with its mating slot in the lever, as the lever is rotated CCW to bring its index mark into approximate alignment with the index mark on the transfer case face.
18. While keeping the lower rod end from turning, adjust the turnbuckle to align the lower rod end eye with the lever cross hole.
19. Install the lever cross bolt, washer, and lock nut. Tighten the locknut to 130–145 lb-ft (176–197 N•m).
20. Adjust the turnbuckle as required to achieve a final rigging of the valve per the Fisher SS_260 Vee-ball instruction manual (Form 5290; SS-260 errata sheet, Oct 2004 or later). The final position of the valve must be approached in the valve closing direction, whereby the turnbuckle is being shortened (pushrod in tension), replicating actuator motion.

IMPORTANT **When rigging the SS-260 valve per the Fisher specified procedure, the specified valve seat retainer gap (0.010–0.020 inch/0.25–0.51 mm) is to be that point at which the *smallest* gap can be found around the entire periphery of the gap between the seal and seal protector ring. The ball is to be approximately centered with respect to the seal retainer ring bore.**

21. Without turning the turnbuckle, move the upper and lower turnbuckle jam nuts about 2–4 threads away from the turnbuckle.
22. Apply Loctite 246 compound to the exposed threads between the turnbuckle and the jam nuts.
23. Holding the turnbuckle to prevent its rotation, tighten the jam nuts to 100–120 lb-ft (136-163 N•m). Wipe away excess Loctite.
24. Immediately (before the Loctite sets up) rotate the pushrod by hand to confirm that it is free to rock and that the lower rod end is not jammed against the side of the slot in the lever. If it is jammed, hold the turnbuckle to prevent its rotation while loosening the lower jam nut. Slightly rotate the turnbuckle as required, then re-tighten the lower jam nut while holding the turnbuckle to prevent its rotation. Repeat steps 23 and 24 to achieve a free pushrod.
25. Install the linkage access cover. Tighten screws to 75–100 lb-in (8.5–11.3 N•m).
26. Install the actuator transfer case end plate, orienting the end plate so the shaft position indicator has the word “CLOSED” at the top, and orienting the shaft hub so the pointer aligns with the “CLOSED” index line. Tighten the bolts to 55–70 lb-ft (75–95 N•m).
27. If necessary, adjust the shaft position indicator “pointer” to align with the “CLOSED” position index line on the surrounding indicator scale. Re-tighten the pointer screws to 30–35 lb-in (3.4–4.0 N•m).

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

Separating the Stop/Ratio Actuator from the Transfer Case and Fisher Gas Valve Assembly

⚠WARNING

To prevent possible personal injury, do NOT remove the spring cover (which is spring-loaded to over 4000 lb/17 760 N). The four 0.750-16 UNF spring cover attaching nuts have metal tab locks and should not be disturbed.

1. Shut off the stop/ratio actuator hydraulic pressure.
2. Remove the linkage access cover and transfer case end plate assembly. It is not necessary to remove the shaft position indicator or hub from the end plate.
3. Remove the linkage cross bolt.
4. Provide means to support the Fisher gas valve/transfer case assembly and to support and lift the stop/ratio actuator.
5. Remove the four hex head 0.750-10 UNC bolts that attach the actuator to the transfer case.
6. Lift the actuator way from the transfer case/valve assembly.

Joining the Actuator to the Transfer Case and Gas Valve Assembly

1. Remove the linkage access cover and end plate from the actuator transfer case.
2. Remove the lower rod end and its jam nut from the actuator pushrod.
3. Remove the turnbuckle from the actuator pushrod. Leave its jam nut on the pushrod.
4. Supporting both the actuator and the Fisher gas valve, join the actuator to the valve and transfer case assembly, carefully guiding the actuator pushrod through the transfer case throat.
5. Install the four 0.750-10 UNC bolts that attach the stop/ratio actuator to the transfer case. Tighten these bolts to 160–180 lb-ft (217–244 N•m).
6. Temporarily place the lever onto the valve shaft, oriented approximately as shown in Figure 5-3.
7. Pre-rig the valve by rotating the lever as required. A pry bar inserted through the transfer case inspection window can be used to move the lever.

NOTICE

Refer to the Fisher Vee-Ball® Valve manual for instruction in preventing damage to the valve seal by closing the ball too far.

8. Pre-adjust the Fisher gas valve per the Fisher SS_260 Vee-ball Instruction Manual (Form 5290; SS-260 errata sheet, Oct 2004 or later):
   - Make sure the valve is closed.
   - Insert a screwdriver or pry bar between the outboard ear of the ball and the valve body.
   - Pry the ball tightly against the thrust washer and the bearing on the actuator side of the valve.
   - Pre-position the Fisher gas valve in the fully closed position, as directed, setting the minimum gap between the valve seal and the seal protector ring is 0.010–0.020 inch (0.25–0.51 mm).
9. Remove the lever, if necessary, and reinstall it, engaging the lever and shaft spline teeth so as to achieve the closest possible alignment of the index marks on the lever face and the transfer case (see Figure 5-3). The lever index mark should be no more than 1.00 inch (25.4 mm) above (CCW from) the transfer case index mark and should be more than 0.50 inch (12.7 mm) below (CW from) the case index mark.
10. Push the lever onto the shaft so that it contacts, or nearly contacts, the bronze shaft bearing in the back of the actuator transfer case.
11. Install the lever clamp bolt, and lock nut. Push the lever inward so that it contacts the rear bearing and tighten the lever clamp bolt. Tighten the lever clamp bolt to 50–70 lb-ft (68–95 N•m).
12. Rotate the lever CW (opening valve direction) to clear the pushrod linkage.

⚠WARNING	**Do not allow the Vee-Ball Valve to rotate much beyond its fully closed position in the closing direction.**

13. Preset the jam nut on the pushrod so that 1.00 ±0.03 inch (25.4 ±0.8 mm) of thread is exposed between the jam nut and the end of the pushrod.
14. Install the turnbuckle on the pushrod so that the turnbuckle contacts the jam nut. Do not yet tighten the nut.
15. Pre-set the jam nut on the lower rod end so that 1.00 ±0.03 inch (25.4 ±0.8 mm) of thread is exposed between the jam nut and the end of the rod end.
16. While keeping the turnbuckle from turning, install the lower rod end into the turnbuckle until its preset jam nut contacts the turnbuckle. Do not tighten the jam nut yet.
17. With minimal rotation of the lower rod end, align the lower rod end with its mating slot in the lever, as the lever is rotated CCW to bring its index mark into approximate alignment with the index mark on the transfer case face.
18. While keeping the lower rod end from turning, adjust the turnbuckle to align the lower rod end eye with the lever cross hole.
19. Install the lever cross bolt, washer, and lock nut. Tighten the locknut to 130–145 lb-ft (176–197 N•m).
20. Adjust the turnbuckle as required to achieve a final rigging of the valve per the Fisher SS_260 Vee-ball Instruction Manual (Form 5290; SS-260 errata sheet, Oct 2004 or later). The final position of the valve must be approached in the valve closing direction, whereby the turnbuckle is being shortened (pushrod in tension), replicating actuator motion.

IMPORTANT	**When rigging the SS-260 valve per the Fisher specified procedure, the specified valve seat retainer gap (0.010–0.020 inch/0.25–0.51 mm) is to be that point at which the *smallest* gap can be found around the entire periphery of the gap between the seal and seal protector ring. The ball is to be approximately centered with respect to the seal retainer ring bore.**

21. Without turning the turnbuckle, move the upper and lower turnbuckle jam nuts about 2–4 threads away from the turnbuckle.
22. Apply Loctite 246 compound to the exposed threads between the turnbuckle and the jam nuts.
23. Holding the turnbuckle to prevent its rotation, tighten the jam nuts to 100–120 lb-ft (136-163 N•m). Wipe away excess Loctite.

24. Immediately (before the Loctite sets up) rotate the pushrod by hand to confirm that it is free to rock and that the lower rod end is not jammed against the side of the slot in the lever. If it is jammed, hold the turnbuckle to prevent its rotation while loosening the lower jam nut. Slightly rotate the turnbuckle as required, then re-tighten the lower jam nut while holding the turnbuckle to prevent its rotation. Repeat steps 23 and 24 to achieve a free pushrod.
25. Install the linkage access cover. Tighten screws to 75–100 lb-in (8.5–11.3 N•m).
26. Install the actuator transfer case end plate, orienting the end plate so the shaft position indicator has the word "CLOSED" at the top and orienting the shaft hub so the pointer aligns with the "CLOSED" index line. Tighten the bolts to 55–70 lb-ft (75–95 N•m).
27. If necessary, adjust the shaft position indicator "pointer" to align with the "CLOSED" position index line on the surrounding indicator scale. Re-tighten the pointer screws to 30–35 lb-in (3.4–4.0 N•m).

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

Changing Right-hand Actuator to Left-hand

NOTICE

Refer to the Fisher Vee-Ball Valve manual for instruction in preventing damage to the valve seal by closing the ball too far.

IMPORTANT

Execution of this procedure requires that the Fisher Vee-Ball be removed from the pipeline.

1. The SS-260 valve orientation (RH) shown on the outline drawing (Figure 1-2) is Woodward's standard orientation (Fisher Style B, position 1). The following procedure is given to facilitate installation where the standard orientation cannot be accommodated.
2. Separate the actuator / transfer case assembly from the Fisher gas valve, following the instructions above.
3. Referring to the appropriate Fisher manual (Form 5290, Type Vee-Ball), change the mounting yoke and lever from Style B to Style C. Maintain action PDTO (Push Down To Open) and position 1 (vertical actuator above the horizontal pipeline).
4. Join the actuator/transfer case assembly to the Fisher gas valve, following the instructions above.

⚠WARNING

Do not allow the Vee-Ball Valve to rotate much beyond its fully closed position in the closing direction.

NOTICE

Entrapped air may defeat the hydraulic cushion action of the actuator, resulting in excessive impact forces during a "trip" command. So, during the initial start-up and prior to operation following service of the actuator, oil filter, or hydraulic supply line, the following procedure must be completed before the unit is commanded to "trip".

- **Bleed entrapped air from the hydraulic line supplying the actuator.**
- **Command the actuator to rapidly stroke (but do not command it to "trip") between its fully retracted and fully extended positions at least 20 cycles to purge entrapped air from the actuator.**

This precautionary procedure is especially important when the actuator is oriented horizontally or upside-down (actuator below the process valve). There is risk of actuator damage if it is commanded to "trip" before entrapped air has been removed from the actuator and from the hydraulic supply line.

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 stop/ratio valve.

Disassembly of the gas fuel stop/ratio 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, servo valve, trip relay valve) as needed. Otherwise, return actuator to Woodward for service.
	Dynamic O-ring seal missing or deteriorated	Return actuator to Woodward for service.
Internal hydraulic leakage	Servo valve internal O-ring seal(s) missing or deteriorated	Replace servo valve.
	Servo valve metering edges worn	Replace servo valve.
	Piston seal missing or deteriorated	Return actuator 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 4.
	Piping flange bolts improperly torqued	Rework bolts as needed to achieve torque requirements detailed in Chapter 4.
	Packing follower needs adjustment	Adjust follower per Fisher manual Form 5290, Type Vee-Ball.
	Packing missing or deteriorated	Service packing per Fisher manual Form 5290, Type Vee-Ball.

Symptom	Possible Causes	Remedies
Internal gas fuel leakage	Vee-Ball seal missing or deteriorated	Service seal per Fisher manual Form 5290, Type Vee-Ball, and Fisher Errata Sheet Type Vee-Ball SS-260.
Valve will not open	Servo valve command current incorrect. (The sum of the current through the three coils of the servo valve must be greater than the null bias of the servo valve for the gas valve to open.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figure 1-4) and the system wiring schematic(s). Pay special attention to the polarity of the wiring to the servo valve and LVDT.
	Servo valve failure	Replace servo valve.
	Hydraulic supply pressure inadequate	Supply pressure must be greater than 1200 psig/8274 kPa (1600 psig/11 032 kPa preferred).
	Trip relay pressure inadequate	Trip pressure must be greater than 40 psid (276 kPa) above drain pressure.
	Vee-Ball jammed	Service Vee-Ball per Fisher manual Form 5290, Type Vee-Ball.
Valve will not close	Servo valve command current incorrect. (The sum of the current through the three coils of the servo valve must be less than the null bias of the servo valve for the gas valve to close.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figure 1-4) and the system wiring schematic(s). Pay special attention to the polarity of the wiring to the servo valve and LVDT.
	Servo valve failure	Replace servo valve.
	LVDT failure	Replace LVDT.
	Springs broken	Return actuator to Woodward for service.
	Linkage broken	Return actuator to Woodward for service.
	Vee-Ball jammed	Service Vee-Ball per Fisher manual Form 5290, Type Vee-Ball and errata sheet Vee-Ball SS-260.
Valve will not respond smoothly	Hydraulic filter clogged	Check the differential pressure indicator on the filter housing.
	Servo valve spool sticking	Verify hydraulic contamination levels are within recommendations of Chapter 1. The use of dither may improve performance in contaminated systems.
	Servo valve internal pilot filter clogged	Replace servo valve.
	Excessive friction in Vee-Ball assembly	Service Vee-Ball per Fisher manual Form 5290, Type Vee-Ball, and Fisher Errata Sheet Type Vee-Ball SS-260.
	Rod-end(s) worn out	Return actuator to Woodward for service.
	Piston seal worn out	Return actuator to Woodward for service.
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.
Valve falsely trips to closed position	Trip pressure is too low	Assure that trip pressure is per specifications.
	Drain pressure is too high or is surging to too high a value	Reduce drain pressure. Reduce restrictions in drain line. Reduce drain line flow surges causing drain line pressure surges.

Chapter 6. Safety Management – Safe Position Fuel Shutoff Function

Safety Function

The Gas Stop/Ratio Valve will move to the closed position within the full stroke trip time listed in this manual.

Product Variations Certified

The SIL (Safety Integrity Level) rated Gas Stop/Ratio Valves for fuel shutoff are designed and certified to the functional safety standards according to IEC 61508, Parts 1 through 7. Reference the exida FMEDA report: WOO 19/05-012 R002, and Certification: WOO 1905012 C001. The exida FMEDA report is available on a per request basis from Woodward.

The functional safety requirements in this chapter apply to all Gas Stop/Ratio Valve configurations listed in Table 6-1.

The The Gas Stop/Ratio Valve configurations listed in Table 5-1 are certified for use in applications up to SIL 3 according to IEC 61508. The SIL of an entire SIF (Safety Instrumented Function)must be verified via calculation of Average PFD (Probability of Failure on Demand) considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair and the specific failure rates of all products included in the SIF. Each element must be checked to assure compliance with the minimum HFT (Hardware Fault Tolerance) requirements.

The SonicFlo™ Gas Fuel Control Valves are classified as a device that is part Type A element according to IEC 61508, having a HFT of 0.

The Gas Stop/Ratio Valves are designed and verified to withstand the worst-case (or greater) expected environmental conditions as listed in other sections of this manual.

SFF (Safe Failure Fraction) for Gas Stop/Ratio Valve – Over Speed SIF

The Gas Stop/Ratio Valve is only one part of a shutoff system that supports an over-speed shutdown SIF. This system consists of a speed sensor, a processing unit and a fuel shutoff actuation subsystem of which Gas Stop/Ratio Valve 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 Gas Stop/Ratio Valve, do not include failures due to wear-out of any components and are only valid for the useful lifetime of the Gas Stop/Ratio Valve. They reflect random failures and include failures due to external events such as unexpected use. Reference the exida FMEDA report: WOO 19/05-012 R002 for detailed information concerning the SFF and PFD.

Failure Rates for Static Applications[1] with Good Maintenance Assumptions in FIT @ SSI=2

Table 6-1. Failure Rates according to IEC 61508 in FIT

Application/Device/Configuration	λSD	λSU [2]	λDD	λDU	#	E
Full Stroke, Clean Service, Hydraulic Trip	0	197	0	803	2088	575
Full Stroke, Clean Service, Electric Trip	0	575	0	923	2301	585
Full Stroke, Clean Service, Hydraulic Trip, with PVST	69	128	429	374	2088	575
Full Stroke, Clean Service, Electric Trip, with PVST	443	132	526	397	2301	585

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. Reference the exida FMEDA report: WOO 19/05-012 R002for additional information, including the assumptions used for the calculated FIT (Failure in Time) values in Table 5-1.

To claim diagnostic coverage for Partial Valve Stroke Testing (PVST), the PVST must be automatically performed at a rate at least ten times faster than the demand frequency with inclusions of position detection from the actuator's LVDT(s). Additionally, the PVST of the safety instrumented function must provide a full cycle test of the solenoid and/or hydraulic pilot valve depending on the device configuration. In cases where this is not true, another method must be used to perform a full solenoid/pilot valve cycle during automated diagnostics in order to use the PVST numbers.

Response Time Data

The Gas Stop/Ratio Valve full stroke trip time is as listed in this manual.

Limitations

When proper installation, maintenance, proof testing, and environmental limitations are observed, the design life of the Gas Stop/Ratio Valve is 250,000 hours of operation. Under "normal" operating conditions Gas Stop/Ratio Valves should be serviced with a factory or authorized service center overhaul every 50,000 hours not to exceed 6 years in service. Refer to service bulletin 01614 for additional service guidelines.

Management of Functional Safety

The Gas Stop/Ratio Valve is intended for use according to the requirements of a safety lifecycle management process such as IEC 61508 or IEC 61511. The safety performance numbers in this chapter can be used for the evaluation of the overall safety lifecycle.

[1] Static Application failure rates are applicable if the device is static for a period of more than 200 hours.
[2] It is important to realize that the No Effect failures are no longer included in the Safe Undetected failure category according to IEC 61508, ed2, 2010.

Restrictions

The user must complete a full functional check of the Gas Stop/Ratio Valve after initial installation, and after any modification of the overall safety system. No modification shall be made to the Gas Stop/Ratio Valve 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.

Competence of Personnel

All personnel involved in the installation and maintenance of the Gas Stop/Ratio Valve must have appropriate training. Training and guidance materials are included in this manual.
These personnel shall report back to Woodward any failures detected during operation that may impact functional safety.

Operation and Maintenance Practice

A periodic proof (functional) test of the Gas Stop/Ratio Valve is required to verify that any dangerous faults not detected by safety controller internal run-time diagnostics are detected. 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 Gas Stop/Ratio Valve 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.

No special tools are required for operation or maintenance of the SonicFlo™ Gas Fuel Control Valve.

Installation and Site Acceptance Testing

Installation and use of the Gas Stop/Ratio Valve must conform to the guidelines and restrictions included in this manual.

Functional Testing after Initial Installation

A functional test of Gas Stop/Ratio Valve is required prior to use in a safety system. This should be done as part of the overall safety system installation check and should include all I/O interfaces to and from the Gas Stop/Ratio Valve. For guidance on the functional test, see the Proof Test procedure below.

Functional Testing after Changes

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

Proof Test (Functional Test)

The SonicFlo™ Gas Fuel Control Valve must be periodically proof tested to ensure there are no dangerous faults present that are not detected by on-line diagnostics. This proof test should be performed at least once per year.

Suggested Proof Test

The suggested proof test consists of a full stroke of the valve, shown in the table below.

Table 6-2. Suggested Proof Test

Step	Action
1	Bypass the safety function and take appropriate action to avoid a false trip.
2	Issue a trip command to the Gas Stop/Ratio Valve to force the actuator/valve assembly to the Fail-Safe state and confirm that the Safe State was achieved and within the correct time.
Note:	This tests for all failures that could prevent the functioning of the control valve as well as the rest of the final control element.
3	Inspect the actuator and valve for any leaks, visible damage or contamination.
4	Re-store the original supply/input to the actuator and confirm that the normal operating state was achieved.
5	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.

Proof Test Coverage

The Proof Test Coverage for the Gas Stop/Ratio Valve is given in the table below.

Table 6-3. Proof Test Coverage

Device	λDUPT5F (FIT)	Proof Test Coverage	
		No PVST	with PVST
Full Stroke, Clean Service, Hydraulic Trip	247	69%	34%
Full Stroke, Clean Service, Electric Trip	252	73%	37%

The suggested proof test and proof test coverage is referenced in exida FMEDA report; WOO 19/05-012 R002.

Terms and Definitions

Safety Freedom	Freedom from unacceptable risk of harm
Basic Safety	The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition
Functional Safety	The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment / machinery / plant / apparatus under control of the system
Safety Assessment	The investigation to arrive at a judgment - based on evidence - of the safety achieved by safety-related systems
Element	Part of a subsystem comprising a single component or any group of components that performs one or more element safety functions
Fail-Safe State	State of the process when safety is achieved; A loss or significant decrease of inlet supply pressure establish high volume reverse flow exhaust
Fail Safe	Failure that causes the hydraulic interface valve to go to the defined fail-safe state without a demand from the process
Fail Dangerous	Failure that does not permit the SIF to respond to a demand from the process (i.e. being unable to go to the defined fail-safe state)
Fail Dangerous Undetected	Failure that is dangerous and that is not being diagnosed by automatic testing
Fail Dangerous Detected	Failure that is dangerous but is detected by automatic testing
Fail Annunciation Undetected	Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic and is not detected by another diagnostic
Fail Annunciation Detected	Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic or false diagnostic indication
Fail No Effect	Failure of a component that is part of the safety function but that has no effect on the safety function
Low Demand Mode	Mode where the safety function is only performed on demand, to transfer the EUC into a specified safe state, and where the frequency of demands is no greater than one per year and no greater than twice the proof test frequency
High Demand Mode	Mode where the safety function is only performed on demand, to transfer the EUC into a specified safe state, and where the frequency of demands is greater than one per year or greater than twice the proof test frequency
Continuous Mode	Mode where the safety function maintains the EUC in a safe state as part of normal operation

Acronyms

EUC	Equipment Under Control
FMEDA	Failure Modes, Effects and Diagnostic Analysis
HFT	Hardware Fault Tolerance
MOC	Management of Change. These are specific procedures to follow for any work activities in compliance with government regulatory authorities or requirements of a standard
PFDavg	Average Probability of Failure on Demand
PFH	Probability of Failure per Hour
SFF	Safe Failure Fraction, the fraction of the overall failure rate of an element that results in either a safe fault or a diagnosed dangerous fault
SIF	Safety Instrumented Function, a set of equipment intended to reduce the risk due to a specific hazard (a safety loop)
SIL	Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems where Safety Integrity Level 4 is the highest level and Safety Integrity Level 1 is the lowest
SIS	Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s)

Chapter 7.
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:

- Part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- 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 the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com**, which also contains the most current product support and contact information.

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

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany:	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (32) 422-5551
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (32) 422-5551
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 8818 5515
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+ 82 (32) 422-5551
The Netherlands	+31 (23) 5661111
Poland	+48 (12) 295 13 00
United States	+1 (970) 482-5811

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 AA—
- Added "8-inch" to the manual title
- Removed GE references
- Updated Table 1-1 to reflect all three configurations covered by the manual
- Revised Pressure Equipment Directive (Fisher Valve)
- Updated Declarations

Changes in Revision Y—
- Replaced and reorganized the entire Regulatory Compliance section
- Added SIL certification information to Regulatory Compliance section
- Added Chapter 6 Safety Management – Safe Position Fuel Shutoff Function
- Updated Declarations

Changes in Revision W—
- Removed cutaway drawing (former Figure 1-1)
- Removed Table 1-3 “Material List for Figure 1-1”
- Added new drawings 8" SS-260 Gas Stop/Ratio Valve with SST Junction Box which are Figures 1-2a and 1-2b

Changes in Revision V—
- Added IECEx certification information to Regulatory Compliance section

Changes in Revision U—
- Updated Declarations
- Updated Regulatory and Compliance Section
- Inserted Figures 1-5a and 1-5b
- Added content to the Electrical Connections Section in Chapter 4

Changes in Revision T—
- Removed GOST-R text and replaced with EAC Customs Union information in Regulatory Compliance section.
- Updated Declarations

Changes in Revision R—
- Updated ATEX information (page v)
- Updated Declarations

Changes in Revision P—
- Added warnings required by ATEX changes (pages vi, 20, 23)
- Updated Declarations

Changes in Revision N—
- Updated Pressure Equipment Directive and GOST R information
- Updated Declaration of Conformity

Changes in Revision M—
- Added Safety Block instructions (page 24)

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00145-04-CE-02-03
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	Sonic Flo™ Gas Fuel Control Valves Sizes 2", 3", 4" and 6", Classes 300 and 600, Size 8" Class 300
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonization of the laws of the Member States relating to the making available on the market of pressure equipment 2", 3", 4": PED Category II 6", 8": PED Category III Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC). 2014/30/EU is met by evaluation of the physical nature to the EMC protection requirement. Electromagnetically passive or "benign" devices are excluded from the scope of the Directive 2014/30/EU, however, they also meet the protection requirement and intent of the directive.
Markings in addition to CE marking:	Ex II 3 G, Ex nA IIC T3 Gc
Applicable Standards:	ASME B16.34:2013 ASME Boiler and Pressure Vessel Code Section VIII, Div. 2:2010 EN IEC 60079-0:2018 Explosive atmospheres – Part 0: Equipment – General Requirements EN 60079-15, 2010: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n' EN 61000-6-4, 2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments
Conformity Assessment:	PED Module H – Full Quality Assurance CE-0062-PED-H-WDI 001-22-USA Bureau Veritas SAS (0062) 8 Cours du Triangle, 92800 Puteaux – La Defense, FRANCE

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

MANUFACTURER

Signature	[signature]
Full Name	**Annette Lynch**
Position	**Engineering Manager**
Place	**Woodward, Fort Collins, CO, USA**
Date	June 22, 2022

5-09-1183 Rev 36

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

File name: 00146-04-CE-02-01
Manufacturer's Name: WOODWARD INC.
Manufacturer's Address: 1041 Woodward Way
Fort Collins, CO 80524 USA
Model Names: Gas Stop/Ratio Valve, consisting of an electrohydraulic actuator and gas valve
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]
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

January 26, 2022
Date

Document: 5-09-1182 (rev. 19) **PAGE** 1 of 1

EMERSON

EU DECLARATION OF CONFORMITY

Sample - Each DoC is serialized but this represents what will be supplied for V150, V200, V300, SS-260 or V500.

Manufacturer:

Fisher Controls International, LLC
Emerson Automation Solutions
4725 HWY 75 South
Sherman, TX 75090
USA

We hereby declare that the equipment detailed below and information given are in compliance with below mentioned directives. This Declaration of Conformity is issued under the sole responsibility of the manufacturer.

Serial Number	Type	PED Directive 2014/68/EU			ATEX 2014/34/EU		EMC 2014/30/EU	Other Directives
F002222026		Modul	Categorie	PMA	Categorie	Marking		
Valve	Rotary Shaft	H	III	SA351-CG8M_1	2	II 2 GD TX	N/A	N/A
Actuator	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

PED : Name & Address of the Notified Body monitoring the Manufacturer's QA System :
Bureau Veritas SA, 52 Boulevard du Parc, Ile de la Jatte, 92200 Neuilly sur Seine FRANCE
Notified Body I.D. 0062
PED full quality assurance certificate CE-0062-PED-H-FVD 001-19-USA

ATEX : Name & Address of the Notified Body where the technical documentation has been submitted and retained :
SGS Fimko Oy, P.O. Box 30 (Sarkiniementie 3), Helsinki 00211, Finland

The object of the Declaration described above is in conformity with the relevant Union harmonization legislation.

	Harmonized standard used*	Other Technical standards used*
PED	EN1349:2009, EN19:2016, EN16668	ASME B16.34
ATEX	EN13463-1:2009, EN1127-1:2011	N/A
EMC	Refer to electrical components EU DoCs	N/A

*Latest version of the standard applies unless otherwise noted.

Authorized person for the Manufacturer: Barry Hurst

Job Title: QA Manager

Signature: [signature]

Date: 21 May 2019

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We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26276.

B26276:AA

WOODWARD

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

Email and Website—www.woodward.com

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

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