

**Electric SonicFlo™
Gas Fuel Control Valve**

Installation and Operation Manual



General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.



Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual **26311**, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.




Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.



Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual **26311**, *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with . Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Woodward reserves the right to update any portion of this publication at any time. Information provided by Woodward is believed to be correct and reliable. However, no responsibility is assumed by Woodward unless otherwise expressly undertaken.

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Warnings and Notices

Important Definitions



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

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

WARNING

**Overspeed /
Overtemperature /
Overpressure**

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

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

WARNING

**Personal Protective
Equipment**

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

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

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

WARNING

Start-up

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

WARNING

**Automotive
Applications**

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

NOTICE**Battery Charging
Device**

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

Electrostatic Discharge Awareness

NOTICE**Electrostatic
Precautions**

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

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

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

Follow these precautions when working with or near the control.

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

Regulatory Compliance

European Compliance for CE Marking:

Low Voltage Directive: Declared to 73/23/EEC COUNCIL DIRECTIVE of 10 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

Pressure Equipment Directive: Certified to Pressure Equipment Directive 97/23/EC of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment, Category II
Moody International Certificate 90 174

This listing is limited only to those units bearing the LCIE agency identification and markings.

ATEX—Potentially Explosive Atmospheres Directive: Declared to 94/9/EEC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
LCIE 02 ATEX 6154X
Zone 1, Category 2, Group IIG EEx d IIB T3

Other European Compliance:

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

Machinery Directive: Compliance as a component with 98/37/EC COUNCIL DIRECTIVE of 23 July 1998 on the approximation of the laws of the Member States relating to machinery.

EMC Directive: Not applicable to this product. Electromagnetically passive devices are excluded from the scope of the 89/336/EEC Directive. Meets the surge requirements of EN 61000-6-2.

North American Compliance:

CSA: CSA Certified for Class I, Division 1, Groups C & D, T3 at 83 °C Ambient for use in Canada and the United States
Certificate 160584-1304785

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

Special Conditions for Safe Use:

Field wiring for the ESV valve power input must be suitable for at least 97 °C.

A conduit seal must be installed within 457 mm of the conduit entry when the valve is used in Class I, Division 1 or Zone 1 hazardous locations.

Connect the ground terminal to earth ground.

The ESV valve is certified to a Zone 1-Category 2/ Division 1 method of protection. Wiring methods must comply with the Zone 1-Category 2 / Division 1 method of protection when installed in a Zone 2 / Div 2 classified atmosphere.

⚠ WARNING

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

⚠ AVERTISSEMENT

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

Chapter 1.

General Information

Introduction

The Electric SonicFlo™ Valve controls the flow of gas fuel to the combustion system of an industrial or utility gas turbine. The unique design yields either a linear, or a modified equal percentage/linear, flow characteristic unaffected by discharge pressure up to a pressure ratio ($P2/P1$) of at least 0.8. The design also integrates the valve and actuator into a compact assembly. The key characteristics of this valve are a highly linear critical gas flow versus stroke relationship at constant upstream pressure. The integral electric actuator consists of a brushless dc motor, resolver for motor commutation and position sensing, fail-safe spring for fail-safe operation, a soft stop for fail-safe operations, a 150 °C thermal switch for overheat conditions, and a visual position indicator.

This valve is intended to operate with the EM Digital Driver (Woodward part number 8200-216; see Woodward EM/LQ manual 26159).

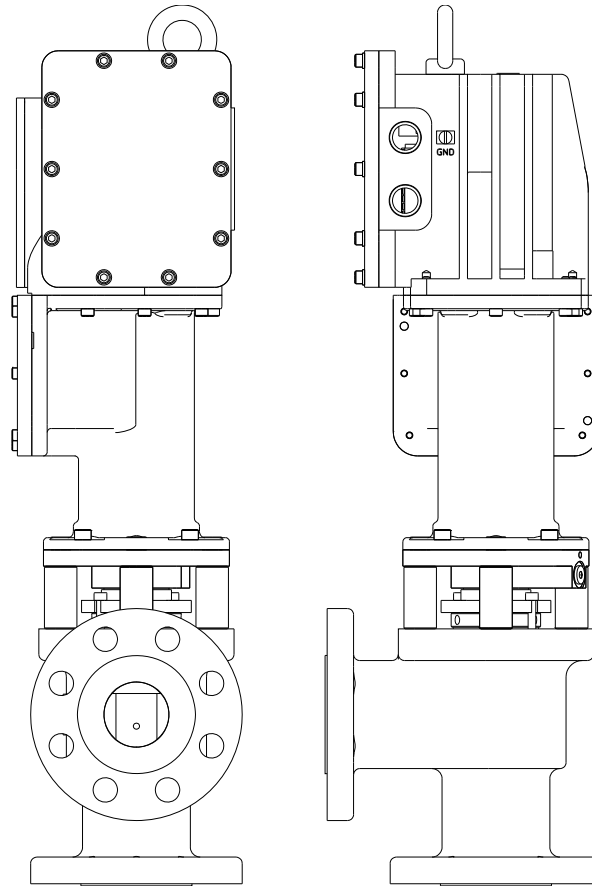


Figure 1-1. Electric SonicFlo Gas Fuel Control Valve

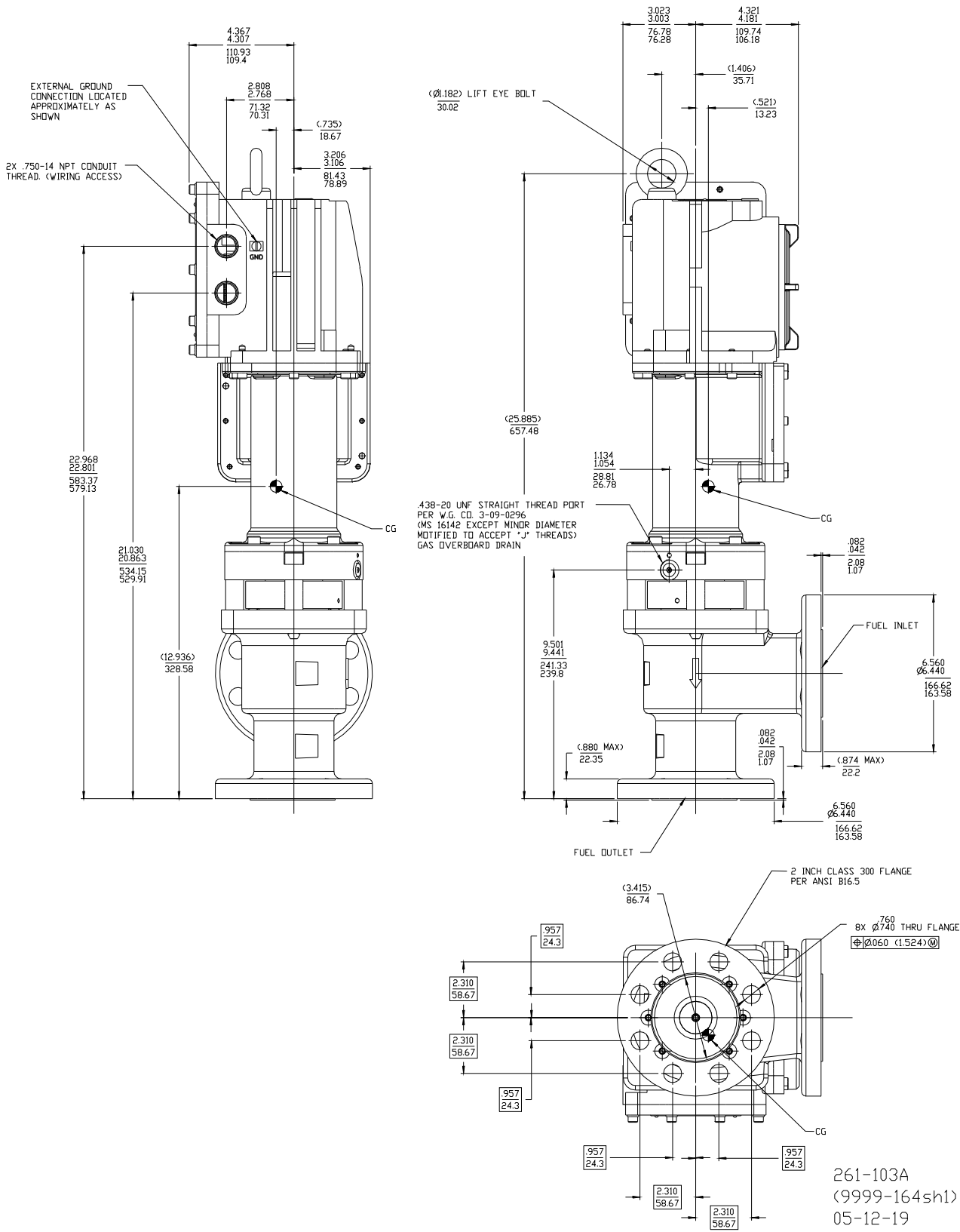


Figure 1-2a. Outline Drawing (2" Control Valve)

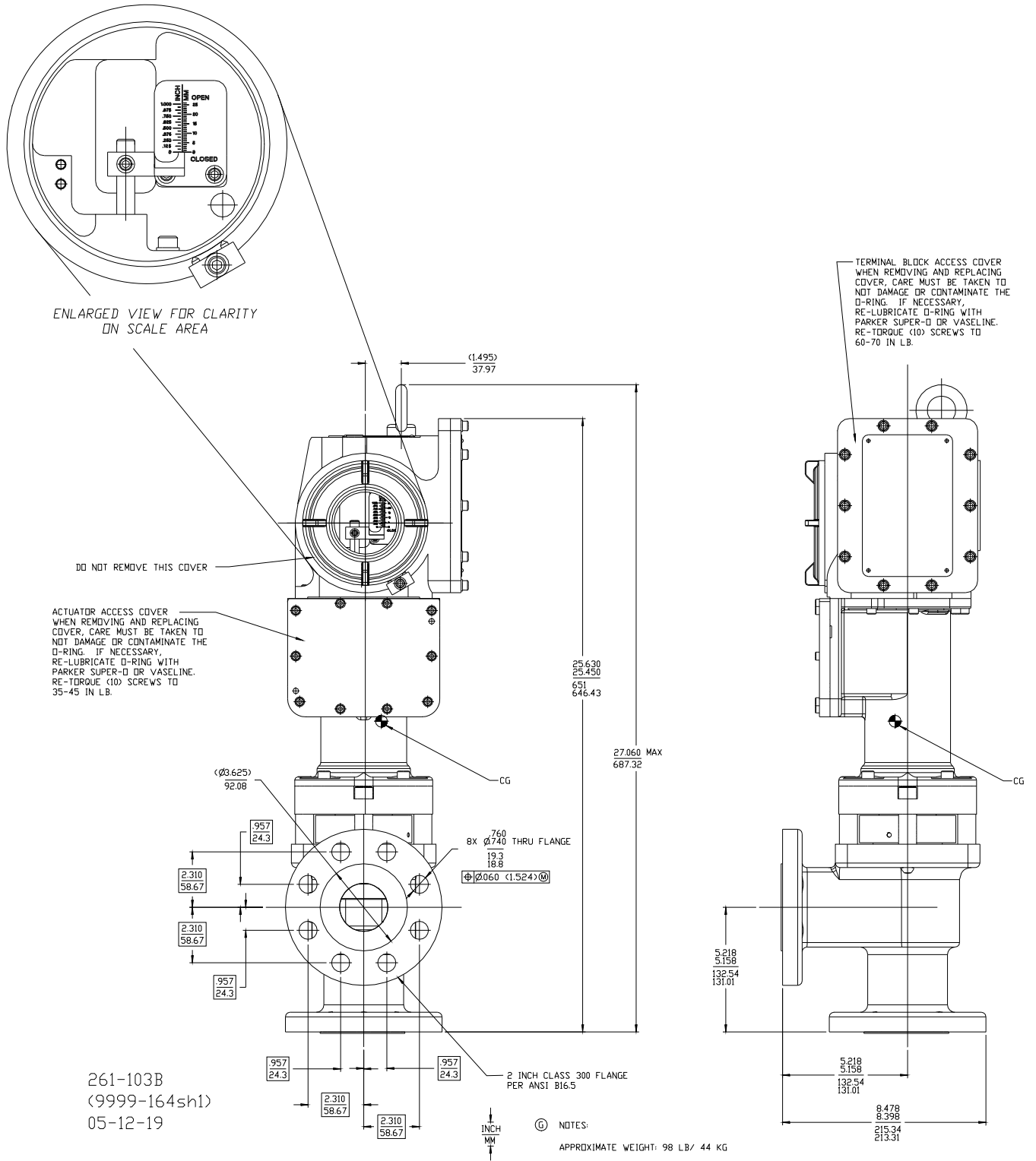


Figure 1-2b. Outline Drawing (2" Control Valve)

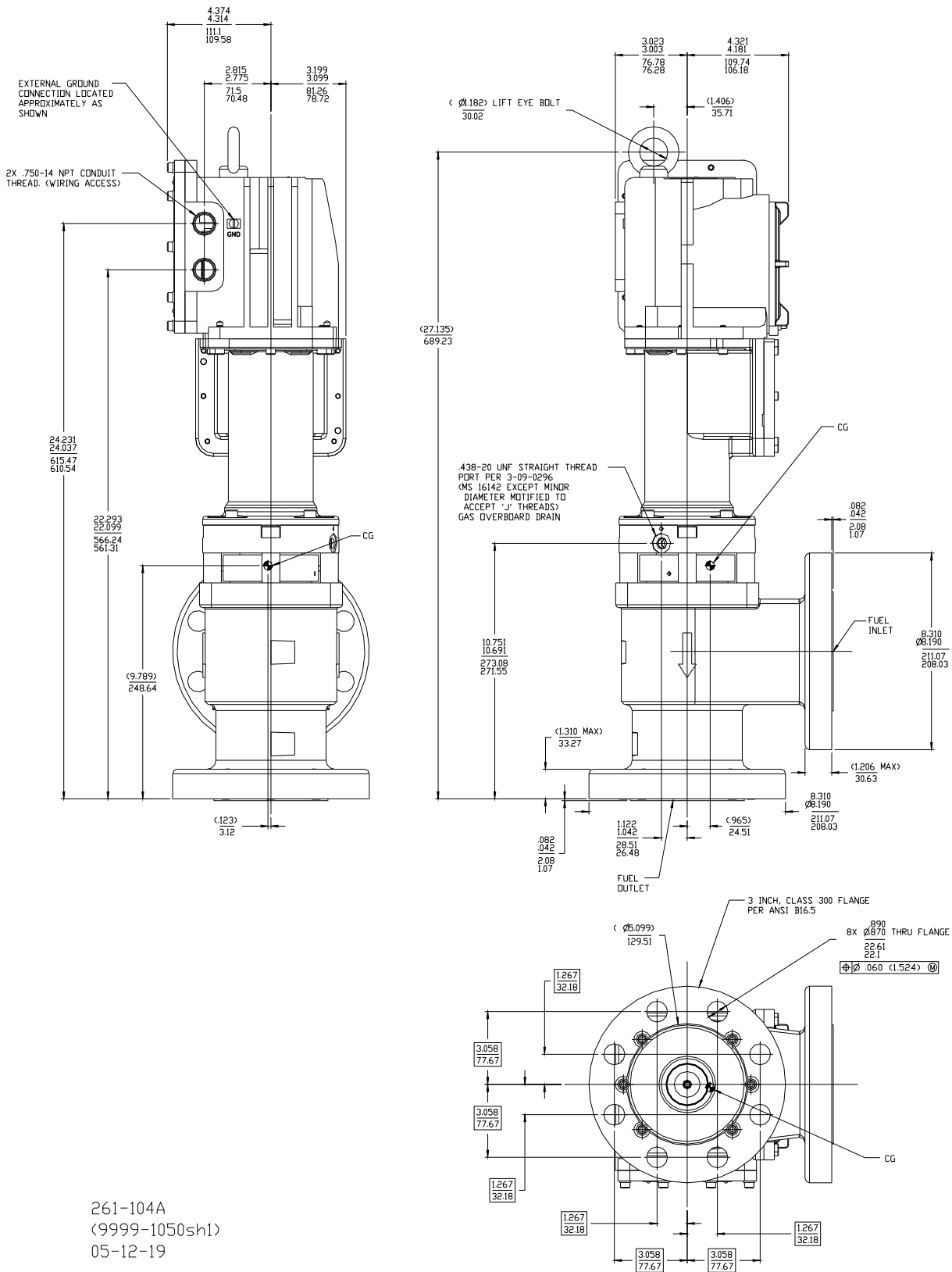


Figure 1-3a. Outline Drawing (3" Control Valve)

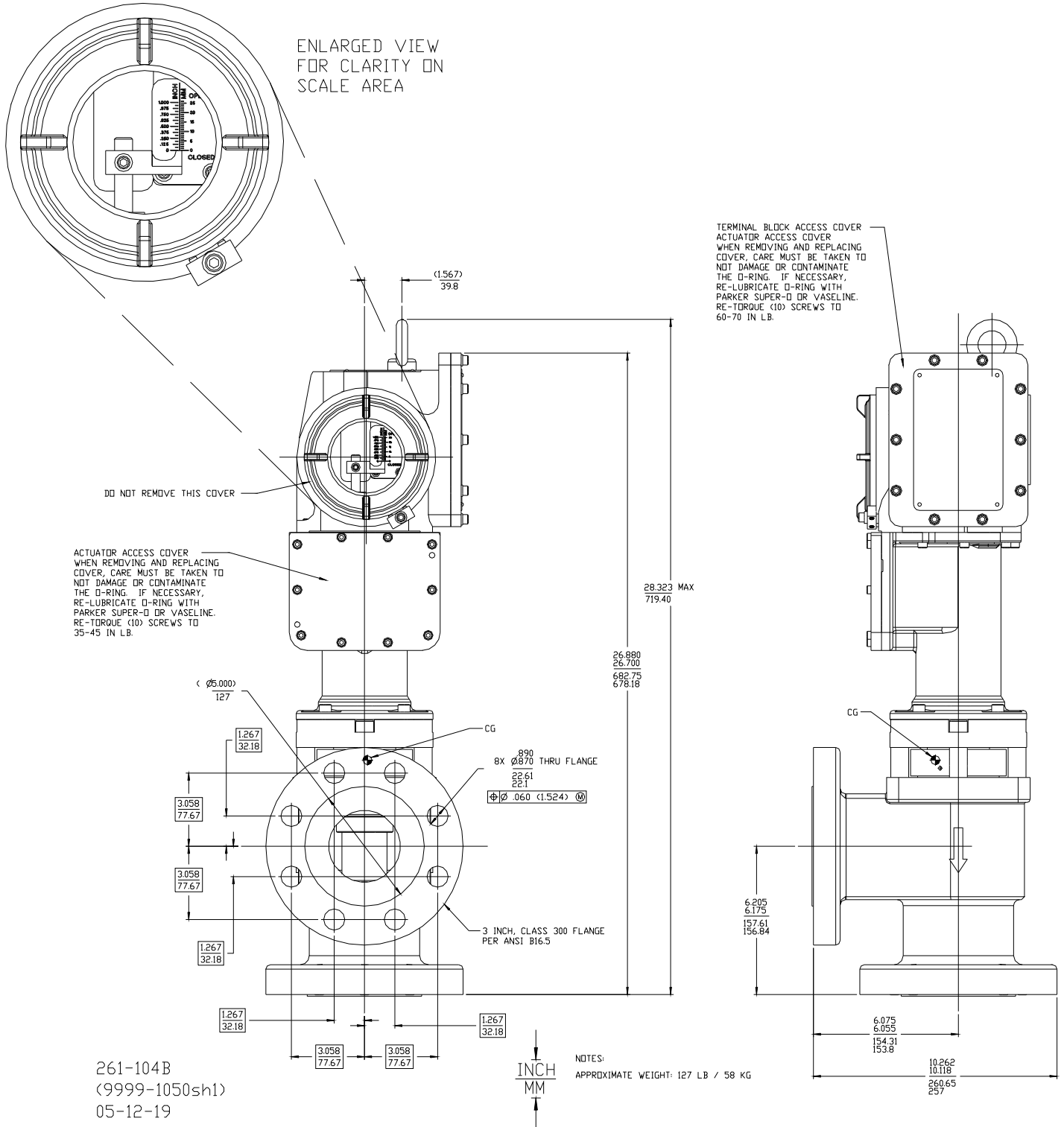


Figure 1-3b. Outline Drawing (3" Control Valve)

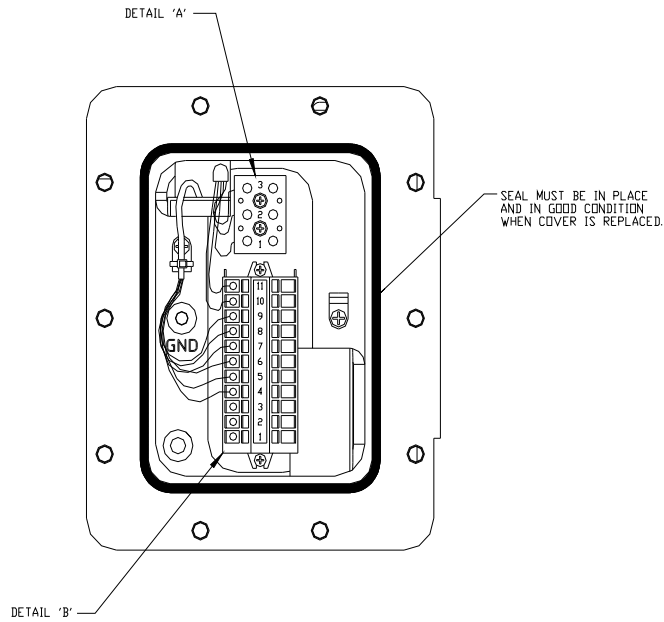
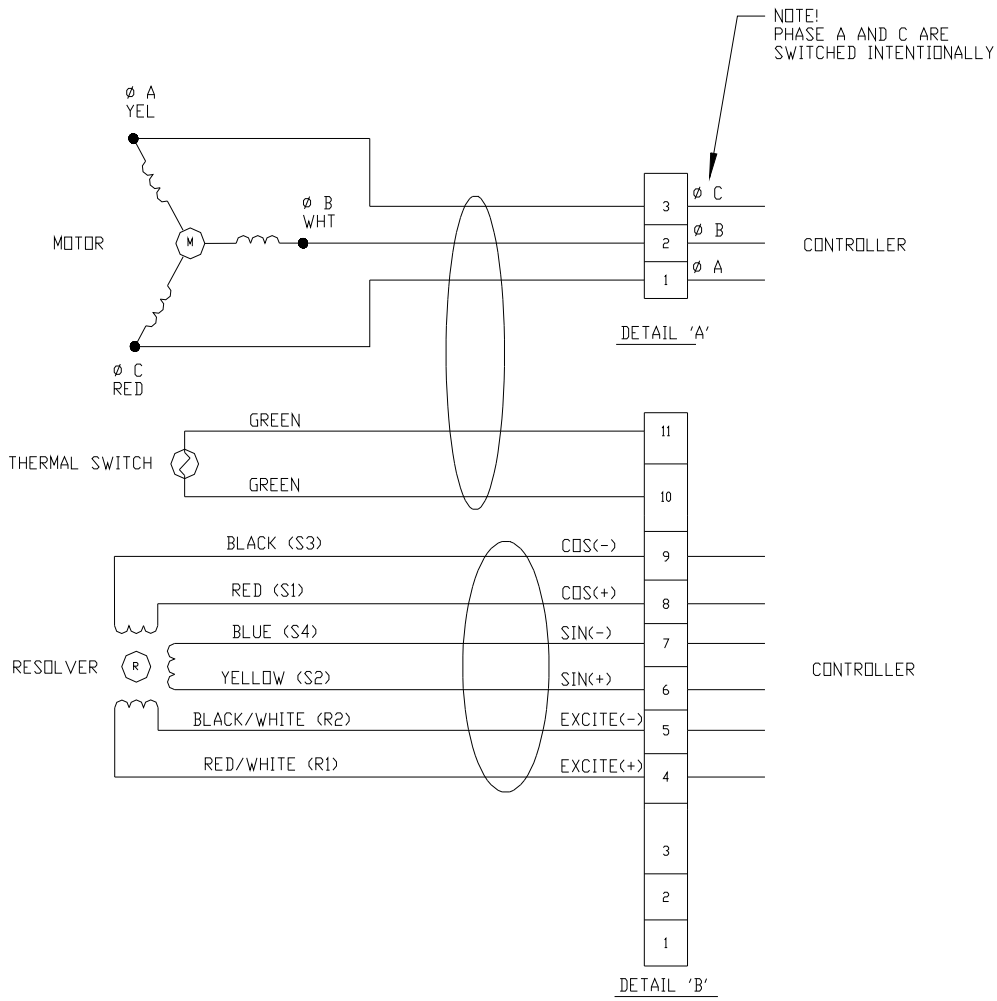
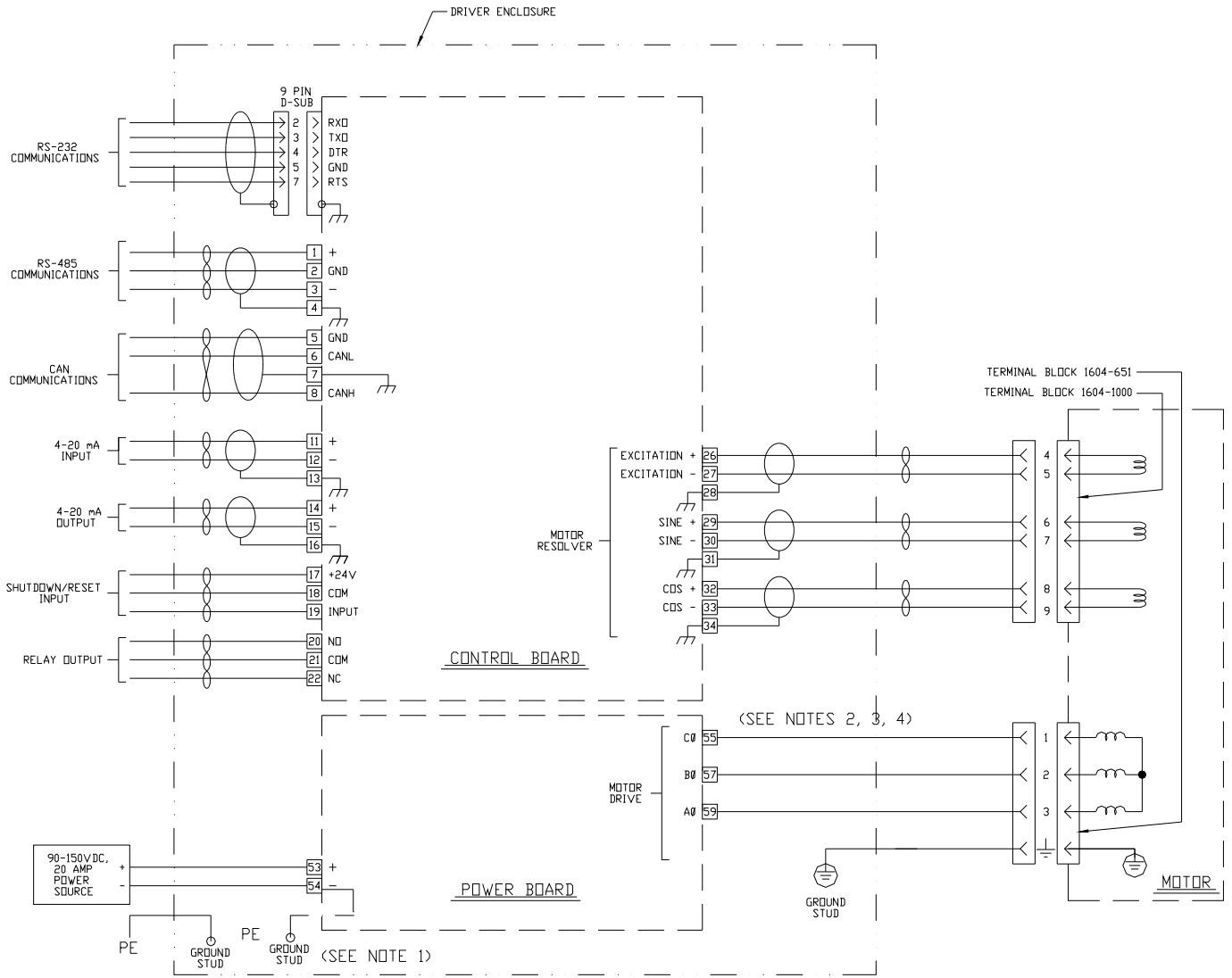


Figure 1-4a. Wiring Diagram



- NOTES:
1. AN OPTIONAL GROUND STUD IS PROVIDED FOR USE WITH AN UNGROUNDED POWER SOURCE.
 2. USE TRIPLE-TWISTED OR TRIPLE TWISTED SHIELDED WIRING FOR MOTOR DRIVE FIELD WIRING.
 3. WIRING MUST BE RATED AT 300 V MINIMUM AND AT THE TEMPERATURE THE WIRING WILL BE SUBJECTED TO IN THE FIELD INSTALLATION.
 4. PHASES A AND C ARE SWITCHED INTENTIONALLY.

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Figure 1-4b.Plant Wiring Diagram

Chapter 2. Description

Valve Characteristics

There are two sizes of the electric sonic valve available. The 2-inch (51 mm) ANSI B16.5 version has a maximum Cg value of 1200 and is rated for a maximum operating pressure of 3103 kPa (450 psig). The 3-inch (76 mm) ANSI B16.5 version has a maximum Cg value of 2000 and is rated for a maximum pressure of 2068 kPa (300 psig).

Electrical Mechanical Actuator Assembly

The electrical-mechanical actuator consists of a brushless dc motor that provides torque, an integral resolver for motor commutation and position feedback to the controller, and a high-efficiency ball screw for rotary-to-linear motion conversion. The actuator also contains a fail-safe spring designed to close the actuator in less than 250 ms if power is removed from the actuator.

- A soft-stop spring to dissipate motor rotor inertia during fail-safe shutdown and prevent ball screw damage
- A cam follower to provide opposing torque during slew operations
- Two terminal blocks for wire connections to the EM Digital Driver Controller
- A lifting eye to aid installation
- An explosion proof environmentally sealed actuator housing

Brushless DC Motor

The ESV brushless dc motor has no commutator brush blocks that require servicing. The motor contains 204 °C (400 °F) temperature rated, lifetime rated grease in the shielded ball bearings that requires no servicing. The motor is designed to produce a total force of 1779 N at 305 mm/s (400 lbs at 12 in/s) in all specified temperatures. The motor is capable of withstanding 204 °C (400 °F) peak temperature before damage. The motor has a 150 °C (302 °F) thermal switch that can send a signal to the EM Digital Driver (where the actuator will send a warning bit to the turbine controller or the signal can be sent directly to the turbine controller).

Resolver Position Feedback Sensors

The ESV brushless resolver is rigged at Woodward for optimum motor commutation performance. The actuator controller performs an automatic rigging sequence to initiate position feedback calibration of the valve to the controller. The controller will drive the actuator open at a predetermined current that will not allow the valve to open. Holding this position, the controller will identify this as the 0% position. From this point, all position control is tracked within ± 0.010 mm (± 0.0004 inches) of accuracy. The resolver excitation is 0.5 Vrms feedback at 4.5 with a maximum input current of 0.058 A.

Visual Indicator

The ESV has a visual indicator that is visible through an explosion-proof sight glass. The indicator is lined up to a scale that reads 1.00 inch (25.4 mm) to read the 100% travel distance.

Chapter 3. Installation

General

See the outline drawings (Figures 1-2 & 1-3) for:

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

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

WARNING

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

AVERTISSEMENT

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

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 temperatures.

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.

CAUTION

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

CAUTION

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.

CAUTION

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

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 ANSI B16.5 for details of flange, gasket, and bolt types and dimensions.

This is a 90° angle valve. Verify that the process piping centerline-to-flange-face dimensions meet the requirements of the outline drawings (Figures 1-2 & 1-3) within standard piping tolerances. The valve should mount between the piping interfaces such that the flange bolts can be installed with only manual pressure applied to align the flanges. Mechanical devices such as hydraulic or mechanical jacks, pulleys, chain-falls, or similar should never be used to force the piping system to align with the valve flanges.

ASTM/ASME grade bolts or studs should be used to install the valve into the process piping. The length and diameter for Class 300 flanges shall conform to the following table according to the valve flange size.

Nominal Pipe Size	Number of Bolts	Diameter of Bolts	Stud Length	Machine Bolt Length
1 inch/ 25 mm	4	5/8 inch/ 16 mm	3.00 inch/ 76.2 mm	2.50 inch/ 63.5 mm
2 inch/ 51 mm	8	3/4 inch/ 19 mm	3.50 inch/ 88.9 mm	3.00 inch/ 76.2 mm
3 inch/ 76 mm	8	3/4 inch/ 19 mm	4.25 inch/ 108.0 mm	3.50 inch/ 88.9 mm
4 inch/ 102 mm	8	3/4 inch/ 19 mm	4.50 inch/ 114.3 mm	3.75 inch/ 95.2 mm
6 inch/ 152 mm	8	3/4 inch/ 19 mm	4.75 inch/ 120.6 mm	4.25 inch/ 108.0 mm
8 inch/ 203 mm	12	7/8 inch/ 22 mm	5.50 inch/ 139.7 mm	4.75 inch/ 120.6 mm

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 studs/bolts in the appropriate sequence in order to keep the flanges of the mating hardware parallel to each other. A two-step torque method is recommended. Once the studs/bolts are hand tightened, torque the studs/bolts in a crossing pattern to half the torque value listed in the following table. Once all studs/bolts have been torqued to half the appropriate value, repeat the pattern until the rated torque value is obtained.

Bolt Size	Torque
5/8 inch/ 16 mm	150–155 lb-ft/ 203–210 N·m
3/4 inch/ 19 mm	250–260 lb-ft/ 339–353 N·m
7/8 inch/ 22 mm	375–390 lb-ft/ 508–529 N·m

Electrical Connections

WARNING

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

NOTICE

Take care not to damage the cover seal, the cover surface, or the wiring compartment surface while removing or replacing the cover.

Do not connect any cable grounds to “instrument ground”, “control ground”, or any non-earth ground system.

IMPORTANT

For Zone 1 / Division 1 products: Proper torque is very important to ensure that the unit is sealed properly. Reference Figures 1-2b and 1-3b.

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 51 mm (2 inches). The wiring should provide signal attenuation to greater than 60 dB.

The brushless dc motor cable should consist of three wires as a shielded twisted bundle. Each wire should be connected to one of the three motor phases as indicated in Figure 1-4 (Wiring Diagram).

The resolver cable must consist of three individually shielded twisted pairs. Two separate pairs should be used for each of the excitation voltages to the resolver. Two separate pairs are used for the resolver sine phase, and two separate pairs are used for the resolver cosine phase, providing the feedback to the controller.

A conduit seal must be installed within 457 mm (18 inches) of the actuator conduit entry to conform with explosion-proof requirements when the ESV is used in hazardous locations.

Damage to sealing surfaces may result in moisture ingress, fire, or explosion. Clean the surface with rubbing alcohol if necessary. Inspect the wiring compartment joint surfaces to ensure that they are not damaged or contaminated.

Fuel Vent Port

There is a fuel vent port that must be vented to a safe location. In normal operation, this vent should have zero leakage. However, if excessive leakage is detected from this vent port, contact a Woodward representative for assistance. NEVER PLUG THE VENT PORT. Plugging the fuel vent port will cause the valve to malfunction or operate improperly.

Electronic Settings—Rigging Procedure

The actuator and controller perform an automatic rigging procedure. When the actuator controller is activated, it performs an automatic rigging procedure that sets the valve to its initial zero percent position. No additional steps are required from the operator.

Chapter 4.

Maintenance and Hardware Replacement

Maintenance

The only maintenance required for the Electric SonicFlo™ Valve is to inspect and lubricate the ball screw every year in accordance with the description below.

In the event that any of the standard components of the valve become inoperative, field replacement 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.

⚠ CAUTION

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

⚠ CAUTION

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

⚠ CAUTION

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.

To facilitate field replacement of items, spare parts should be kept on-site. See the outline drawings (Figures 1-2 & 1-3) for the locations of items. Contact Woodward for a complete list of field-replaceable parts and additional instructions for their replacement.

Ball Screw Lubrication and Inspection Procedure

Inspect and Lubricate Ball Screw Assembly

1. Power wash or clean and dry the outside of the actuator to ensure that no debris gets inside the actuator during lubrication process. Any debris on the ball screw will reduce its life.
2. Remove the ten M5 x 0.8 cap socket head cap screws with a 4 mm hex wrench.

3. Remove the cover by carefully and evenly prying off the cover using the two screwdriver pry points behind the cover as shown in Figure 4-2.
4. Set the cover and O-ring aside and keep clean. Make sure that the inside cover surface and the cover flange on the valve are not scratched or damaged.

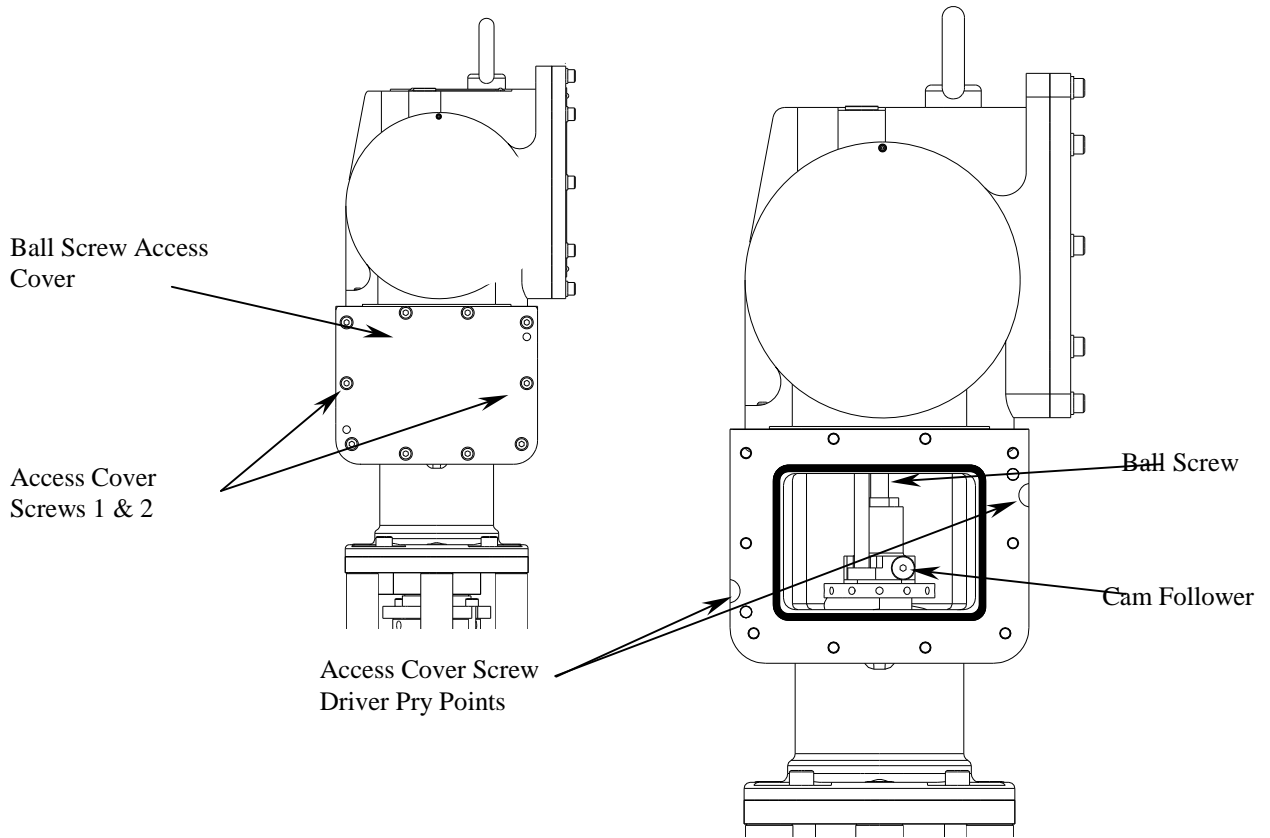


Figure 4-2. ESV Ball Screw Cover and Ball Screw

5. Visually inspect the ball screw threads for physical damage and presence of lubricant. Inspect the grease by using clean hands and touching the ball screw with your index finger, then rubbing the grease between your index finger and thumb. If the grease feels smooth, proceed to step 6. If the grease feels gritty, or thick like tar, contact your Woodward representative.
6. Apply a new film of grease to all exposed areas of the ball screw threads, ensuring complete coverage. For field use, a high quality grease meeting MIL-PRF-23827 or MIL-G-21164 such as Aeroshell 7 or 17 should be used.
7. Inspect the O-ring, the O-ring groove, and the access cover for debris or damage. If cleaning is necessary, wipe clean with a clean cloth and re-lubricate the O-ring with petroleum jelly. If the inside of the access cover has been scratched or damaged, replace it.
8. Install the O-ring and then install the access cover, making sure that there is no debris on the inside cover surface or the mating valve surface.
9. With the O-ring placed back into its groove, replace the access cover. If it does not go on easily, ensure that the cam follower is lined up with the cover groove. The cam follower can be moved by hand or with a pin in the 3.71 mm (0.146 inch) diameter holes below it.

10. Install the ten M5 x 0.8 cap screws with a 4 mm torque wrench. Torque all the screws to 4.0–5.1 N·m (35–45 lb-in).

IMPORTANT

For Zone 1 / Division 1 products: Proper torque is very important to ensure that the unit is sealed properly.

ESV Actuator Rotation Instructions

To rotate the actuator assembly relative to the valve body on an ESV in the field, follow this procedure. Refer to the cutaway view of the ESV cross section in Figure 4-1 for a description of the valve and actuator components.

1. If the overboard vent drain (OBVD) connection on the ESV is connected to external piping, disconnect this piping from the valve. This piping will have to be re-bent once the actuator orientation is changed, because the position of the OBVD will be in a different location.
2. With the valve in an upright position as shown in Figure 4-1, use a 3/8" external hex driver and ratchet to loosen the four 0.500-13 actuator mounting screws. Note that as these screws are threaded out, the screw heads will contact the lower surface of the spring housing, lifting the actuator out of the valve housing bore. Loosen each screw approximately one turn at a time, working in a criss-cross pattern so that the actuator is evenly and squarely lifted from the housing.
3. Once all of the bolt threads are disengaged from the housing, use a hoist or other lifting device to lift the actuator up enough for the bolts to clear the housing. As the actuator is lifted, make sure the four spacers remain engaged with the bolts. Rotate the actuator to the desired position.
4. Once the actuator is in the desired position, and the spacers are properly located between the housing and actuator bonnet, begin threading in the four mounting bolts. Again, thread each bolt in approximately one turn at time, following a criss-cross pattern. As the bolts are threaded in, gravity will lower the actuator into the valve body.
5. Once all four bolts are tight, torque each bolt to an initial value of 45 lb-ft (61 N·m), then repeat the torque sequence at a torque of 90 lb-ft (122 N·m).
6. Re-connect tubing to OBVD connection.
7. Perform a static leak test on the valve to ensure that the O-ring seal between the actuator and valve is functioning properly.
8. Return the valve to service.

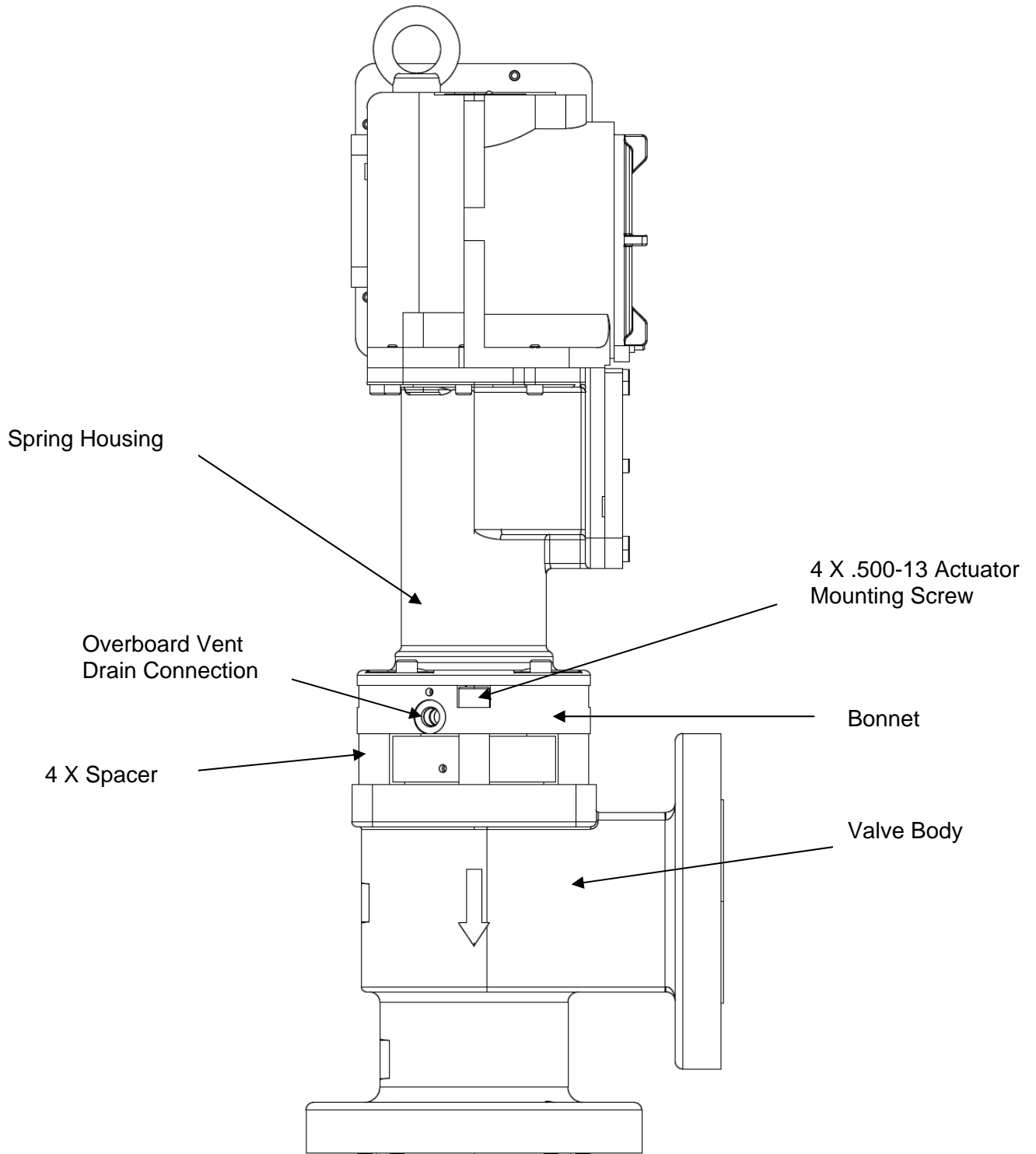


Figure 4-1. Cutaway View of ESV

Chapter 5. Troubleshooting

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 the applicable electronic control manuals for assistance in isolating the trouble. The following steps describe troubleshooting for the gas fuel control valve.

Disassembly of the gas fuel control 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
Valve will not open because driver will not reset	Motor wires not properly connected between driver and actuator	Connect wires according to diagram in this manual. Conduct continuity check.
	Resolver wires not properly connected between driver and actuator	Connect wires according to diagram in this manual. Conduct continuity check.
Driver will reset but valve will not open	Resolver sine wires high and low are flipped	Connect wires according to diagram in this manual. Conduct continuity check.
	Resolver cosine wires high and low are flipped	Connect wires according to diagram in this manual. Conduct continuity check.
	Resolver sine and cosine wires are swapped	Connect wires according to diagram in this manual. Conduct continuity check.
Upon enabling, valve will open and then fail closed	Resolver sine and cosine wires are swapped and sine wires high and low are flipped	Connect wires according to diagram in this manual. Conduct continuity check.
	Resolver sine and cosine wires are swapped and cosine wires high and low are flipped	Connect wires according to diagram in this manual. Conduct continuity check.
Poor flow accuracy	Characterization data in engine control does not match the valve.	Verify characterization data matches the valve serial number.
	Build-up of contamination on the seat	Remove valve and inspect flow elements.
Poor position stability	One motor wire disconnected	Connect wires according to diagram in this manual. Conduct continuity check.
High overboard vent leakage	Internal seals damaged	Return to manufacturer for repair.

Symptom	Possible Causes	Remedies
High seat leakage	Damage to valve seat or plug	Remove valve and inspect flow elements. Return to manufacturer for repair.
	Contamination buildup in seat or plug	Remove valve and inspect flow elements. Return to manufacturer for repair.
	Valve not fully closed	Remove valve and verify plug is not properly seated. Return to manufacturer for repair.
External gas fuel leakage	Piping flange gaskets missing or deteriorated	Replace gaskets.
	Piping flanges improperly aligned	Rework piping as needed to achieve alignment requirements detailed in Chapter 3.
	Piping flange bolts improperly torqued	Rework bolts as needed to achieve torque requirements detailed in Chapter 3.
	Packing missing or deteriorated	Return actuator to Woodward for service.
Valve will not close	Actuator command current incorrect	Trace and verify that all wiring is in accordance with the electrical schematic (Figure 1-4) and the GE system wiring schematic(s). Pay special attention to the polarity of the wiring to the various components.
	Springs broken	Return actuator to Woodward for service.
Valve will not respond smoothly	Voltage supply to driver is insufficient	Verify voltage and current ratings of power supply.
	Piston seal worn out	Return actuator to Woodward for service.
	Control system instability	Contact control system supplier.
Seals wear out prematurely	Contamination level is excessive	Verify contamination levels are within recommendations of turbine manufacturer. 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 $\pm 1\%$) at slow frequencies (on the order of 0.1 Hz) cause wear to accumulate rapidly.	Determine and eliminate the root cause of oscillation. Possible causes include inlet pressure regulation, control system setup, and improper wiring practices. See Chapter 3 Installation section for wiring recommendations.

Chapter 6. Service Options

Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

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

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

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

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: www.woodward.com.

How to Contact Woodward

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

Electrical Power Systems

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

Engine Systems

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

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

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

www.woodward.com/directory

Technical Assistance

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

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Engine/Turbine Model Number _____

Manufacturer _____

Number of Cylinders (if applicable) _____

Type of Fuel (gas, gaseous, steam, etc) _____

Rating _____

Application _____

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

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

Electric SonicFlo™ Valve Specifications

Valve Type	Two way—right angle
Trim Configuration	Exponential (modified equal percentage—exponential to 30% valve position and linear from 30% to 100%) OR linear from 0% to 100%
Type of Operation	Run—valve open Trip—valve closed
Fluid Ports	ANSI Class 300 flanges
Nominal Piping Size	2 inch (51 mm) 3 inch (76 mm)
Flowing Media	Natural gas Materials NACE MR0175 compatible WCB steel bodies and stainless steel stem and trim
Maximum Gas Pressure	2" (51 mm) valve—0 to 3448 kPa (0 to 500 psig) 3" (76 mm) valve—0 to 2068 kPa (0 to 300 psig)
Valve Proof Pressure Level	7757 kPa/1125 psig per ANSI B16.34, ANSI B16.37/ISA S75.19
Minimum Valve Burst Pressure	19 996 kPa/2900 psig (based on 5102 kPa/740 psig max working pressure of Class 300 flange)
Gas Filtration	25 µm absolute at 75 beta requirement
Gas Temperature	–29 to +204 °C (–20 to +400 °F)
Valve Port Size	2" (51 mm)—Cg = 1200—1.1 in ² (710 mm ²)
Flow Characteristics	±3% Cg deviation of point
Valve Ambient Temperature	–29 to +83 °C (–20 to +181 °F)
Shut-off Classification	Class IV per ANSI B16.104/FCI 70-2 (0.01% of rated valve capacity at full travel measured with air at 345 kPa/50 psid)
External Leakage	None
Inter-seal Vent Leakage	Less than 1 cm ³ /min as shipped
Actuator Position Accuracy—	
Digital:	±1% of full scale
4–20 mA Analog Input:	+0.125% full scale. @ 25 °C, +0.042%/°C
4–20 mA Analog Output:	+0.4% full scale @ 25 °C, +0.0094%/°C
Valve Repeatability	±0.5% of point over range of 10% to 100%
Valve to Valve Repeatability	±1% of point over range of 10% to 100%
Voltage Requirements to Controller	90 to 152 Vdc
Current Draw	Continuous: 0.8 A Peak: 6 A
Actuator Ambient Temperature	–29 to +83 °C (–20 to +181 °F)
Actuator Voltage	90 Vdc minimum to 152 Vdc Maximum
Voltage Ripple Limitations	The actuator and controller can tolerate a maximum ac voltage ripple as listed below: 50 Hz at 9.5 Vac peak-to-peak 60 Hz at 8.0 Vac peak-to-peak 100 Hz at 4.8 Vac peak-to-peak 120 Hz at 4.0 Vac peak-to-peak 180 Hz at 2.7 Vac peak-to-peak
Actuator Input Current Rating	10.5 A continuous 20 A peak for 2.5 seconds
Trip Time	Unpowered: Less than 0.350 s Powered: Less than 0.100 s
Slew Time	Driven 2% to 98% and record 10% to 90% in 0.100 s
Vibration Test Level	Per US MIL-STD-810D method 514.3, Category 1, figure 514.3-1
Shock	Per US MIL-STD-810D method 514-3, Category 1.2, procedure I
Resolver excitation	5 Vrms @ 4.5 kHz

Declaration of Incorporation

Woodward Governor Company
1000 E. Drake Road
Fort Collins, Colorado 80525
United States of America

Product: Electric SonicFlo Gas Valve
Part Number: 9904-538 and similar

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado, that the above-referenced product is in conformity with the following EU Directives as they apply to a component:

98/37/EEC (Machinery)

This product is intended to be put into service only upon incorporation into an apparatus/system that itself will meet the requirements of the above Directives and bears the CE mark.

Manufacturer


Signature

Jennifer R. Williams

Full Name

Engineering Project/Process Manager

Position

WGC, Fort Collins, CO, USA

Location

8-20-02

Date

DECLARATION OF CONFORMITY

Manufacturer's Name: WOODWARD GOVERNOR COMPANY (WGC)
Manufacturer's Address: 1000 E. Drake Rd.
Fort Collins, CO, USA, 80525

Model Name(s)/Number(s): 2" and 3" Electric Sonic Valves
9904-538, 9904-553, and similar

Conformance to Directive(s): 73/23/EEC Council Directive of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.
97/23/EC Council Directive of 29 May 1997 on the approximation of the laws of the Member States concerning Pressure Equipment
94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

Marking(s): Category 2 Group II G, EEx d IIB T3

Applicable Standards: EN50014:1998 Electrical apparatus for potentially explosive atmospheres – General requirements
EN50018:2000 Electrical apparatus for potentially explosive atmospheres- Flameproof enclosure 'd'
EN50178, 1997: Electronic Equipment for Use in Power Installations
ASME B31.3b Process Piping, Ed. 99, Ad. 01
ASME Boiler and Pressure Vessel Code VIII, Div. 1, Ed. 98, Ad. 00
ASME Boiler and Pressure Vessel Code II, Part D Ed. 98, Ad. 00

Third Party Certification LCIE 02 ATEX 6154X
LCIE (0081)
Siège Social : 33, Avenue du Général Leclerc
F92260 Fontenay-aux-Roses, France

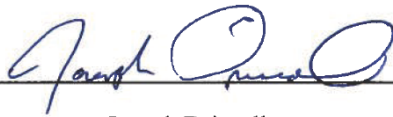
Conformity Assessment: PED Module H – Full Quality Assurance, Certificate 90 174
ATEX Production Quality Assessment, ITS05ATEXQ4211

**Notified Body
For ATEX:** Intertek (0359)
Intertek House, Cleeve Road
Leatherhead, Surrey,
KT22 7SB UK

**Notified Body
For Pressure Equipment:** Moody International Certification Limited (1277)
Stephenson's Way, The Wyvern Business Park
Derby DE21 6LY United Kingdom

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature Joseph Driscoll

Full Name Engineering Manager

Position WGC, Fort Collins, CO, USA

Place

5/4/07

Date

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **26177J**.



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Email and Website—www.woodward.com

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

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