Product Manual 26114
(Revision P, 11/2015)
Original Instructions


SOGAV™ Solenoid Operated Gas Admission Valve

Unbalanced, Bottom-Load SOGAV 250
Unbalanced, Top-Load SOGAV 250

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* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:** **www.woodward.com/publications** **The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.**

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

Translated Publications	**If the cover of this publication states "Translation of the Original Instructions" please note:** **The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.**

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

Contents

Illustrations and Tables

The following are trademarks of Woodward, Inc.:
- In-Pulse
- SOGAV
- Woodward

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

ATEX – Potentially Explosive Atmospheres Directive: Declared to 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 explosive atmospheres. Zone 2, Category 3, Group II G, Ex nA IIC T3 X Gc IP54

Low Voltage Directive: Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

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

Machinery Directive: Compliant as partly completed machinery with Directive 2006/42/EC of the European Parliament and the Council of 17 May 2006 on Machinery.

Pressure Equipment Directive: Exempt per Article 1-3.10

EMC Directive: Not applicable to this product.
Electromagnetically passive devices are excluded from the scope of the 2004/108/EC Directive.

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

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, D, T4 at 105 °C Ambient for use in Canada and the United States.
Certificate 1514353

The SOGAV 250 solenoid is certified as a component for on-engine use. The final assembly is subject to acceptance by the authority having jurisdiction.

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 105 °C.

Connect the ground terminal on the SOGAV 250 solenoid to earth ground.

SOGAV 250 solenoids are labeled with maximum rated values of input current and input power. These input ratings must not be exceeded during solenoid operation in order to prevent exceeding a prescribed coil temperature rise at the maximum rated ambient operating temperature. These solenoids must be driven by specially designed current-limiting drivers providing periodic, two-tier current waveforms. Refer to the Appendix for details on how to determine and interpret these input rating values.

⚠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

Introduction

WARNING

The engine, turbine, or other type of prime mover should be equipped with an independent fuel shut-off device to protect against fuel leakage or damage to the prime mover with possible personal injury, loss of life, or property damage. The fuel shut off device must be totally independent of the prime mover control system.

This manual provides the end user with the information necessary to properly install, operate, maintain, and troubleshoot the Woodward unbalanced/bottom-load and unbalanced/top-load SOGAV 250 (Solenoid Operated Gas Admission Valve) products. See manual 26500 for the balanced/top-load version of the SOGAV 250. It is not possible to predict all applications where the SOGAV may be applied. For new applications, it is recommended that the user contact Woodward for application support early in the design process to work through details that have not been anticipated.

Principles Of Operation

Magnetic

All valve actuation forces are generated magnetically through an E-core solenoid device. Magnetic flux generated in the E-core solenoid assembly attracts a low carbon steel plate (the armature) that is attached to the valve mechanism. The E-core produces very high forces over short travels. The valve mechanism travels 0.50 mm from full closed to full open. The short travel along with the high forces result in fast and consistent opening and closing response.

Valve

The valve is similar to an air (or gas) compressor valve. It is a face type poppet with multiple concentric grooves. The moving metering plate is spring loaded and pressure loaded against the lower stop & metering plate and is pulled off the lower stop & metering plate by the E-core solenoid assembly. When the plates are separated, gas flows from the grooves in the moving metering plate to the grooves in the lower stop & metering plate. When the moving metering plate and the lower stop & metering plate are in contact, gas cannot pass from the grooves in the moving metering plate to the grooves in the lower stop & metering plate.

The groove edges are the metering edges. Overlapped, flat lapped sealing surfaces, spring loading, and pressure imbalance across the moving metering plate provides excellent sealing while the valve is closed.

An array of springs, combined with pressure imbalance across the moving metering plate, rapidly close the valve once the E-core is de-energized. The same array of springs center the moving plate relative to the lower stop & metering plate. This centering technique eliminates sliding (wearing) motion.

The SOGAV 250 is available in a pressure-balanced/top-load version. For more information, see manual 26500.

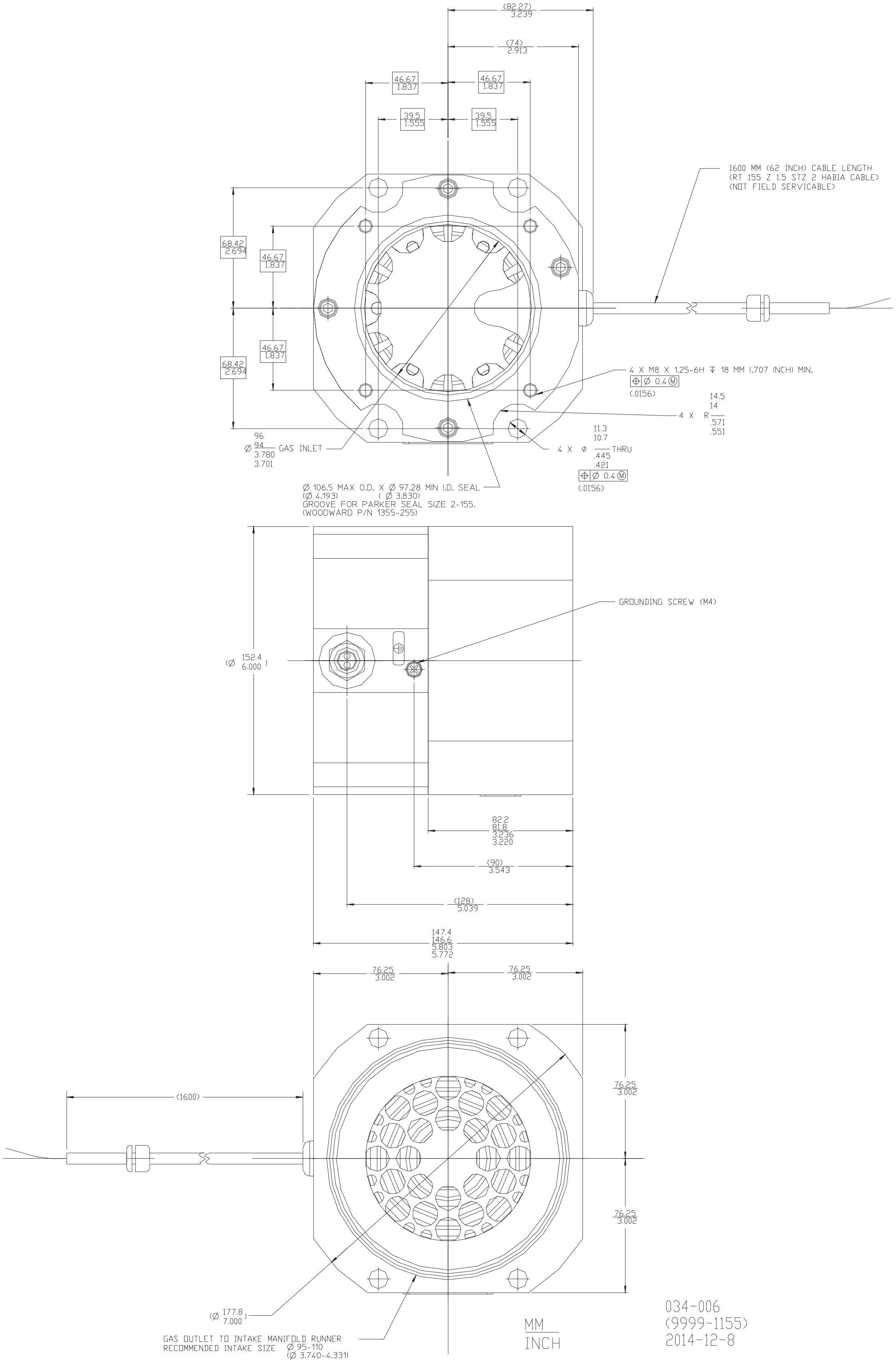


Figure 1-1. SOGAV 250 Outline Drawing (Unbalanced/Bottom-Load)
(Flying Lead Version)

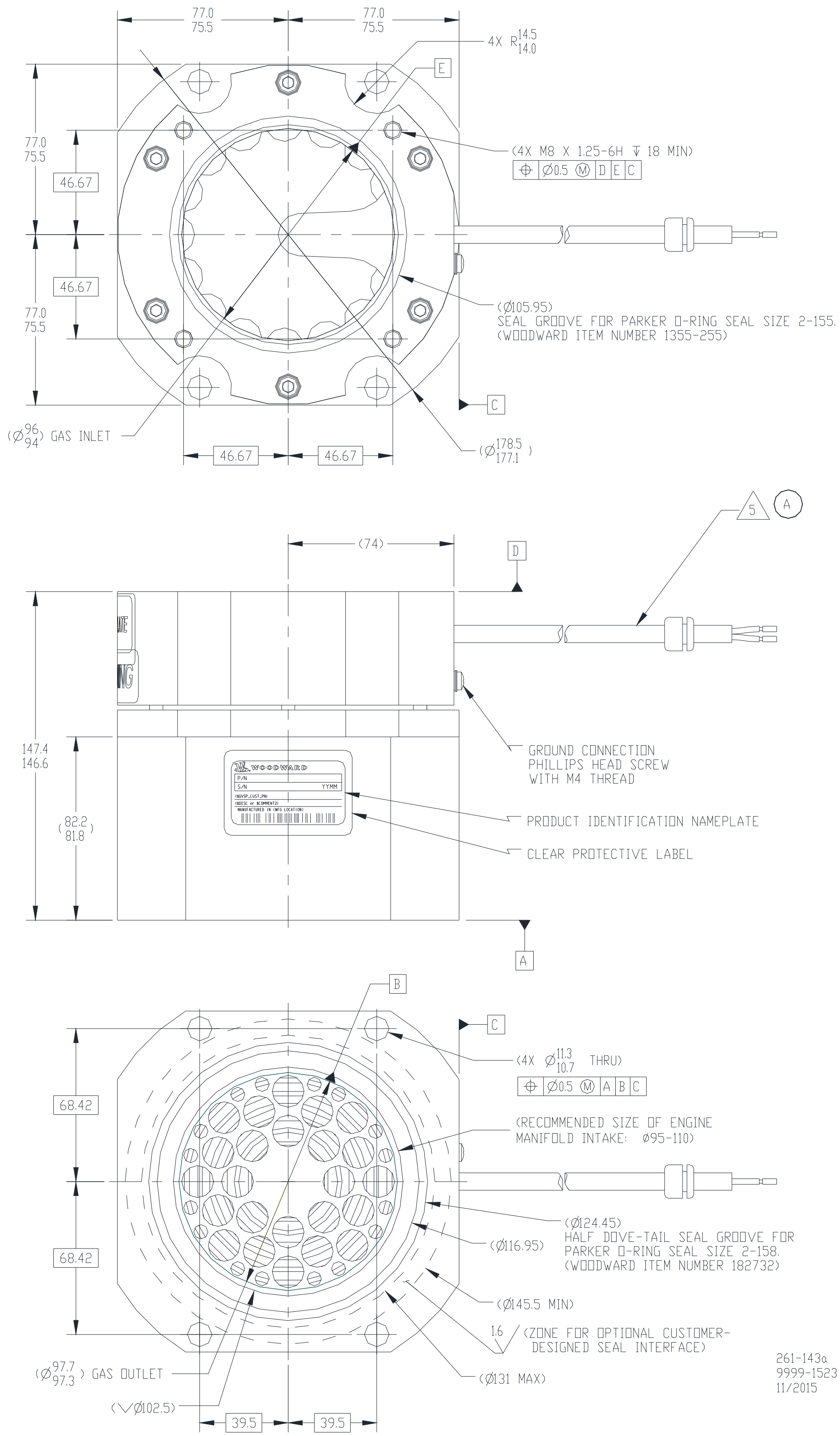
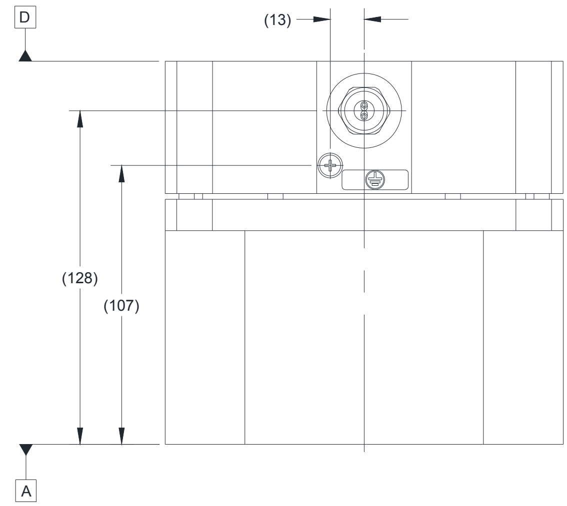


Figure 1-2a. SOGAV 250 Outline Drawing (Unbalanced/Top-Load)
(Flying Lead Version)

PRODUCT CONFIGURATION TABLE		
VALVE ITEM #	CABLE LENGTH (m)	CABLE SHIELD GROUNDED TO VALVE HOUSING?
8402-759	1.6	YES
8402-759-AL	1.6	YES
8402-780-CT	2.5	NO



NOTES

1. INTERPRET DRAWING PER ASME Y14.5-2009.

2. FEATURES AND DIMENSIONS WITHIN PARENTHESES ARE REFERENCE.

3. INTERFACE DESIGN RECOMMENDATIONS --
   A) APPLY SURFACE FINISH REQUIREMENTS TO ALL SEALING AND LEAD-IN FEATURES PER PARKER O-RING HANDBOOK;
   B) USE O-RINGS MADE OF FLUOROCARBON (FKM, VITON) MATERIAL -- OR ANOTHER SUITABLE MATERIAL PER PARKER O-RING HANDBOOK; AND
   C) LUBRICATE (AS NEEDED) AND INSTALL O-RINGS PER PARKER O-RING HANDBOOK.

4. ALL VALVES DESCRIBED IN THIS DOCUMENT ARE TOP-LOAD UN-BALANCED (TLUB) PRODUCTS.

5 CABLE DETAILS:
-- MANUFACTURE: HABIA CABLE
-- DESCRIPTION: RTFRO 2 X 1.50
-- ARTICLE NUMBER: 43171-006-01
-- CABLE TYPE: 2-CONDUCTOR SHIELDED
-- CABLE LENGTH: SEE PRODUCT CONFIGURATION TABLE
-- DIAMETER: 7.3-8.3MM
-- POLARITY: UNIMPORTANT
-- SERVICEABILITY: NONE

261-143b
9999-1523
11/2015

Figure 1-2b. SOGAV 250 Outline Drawing (Unbalanced/Top-Load)
(Flying Lead Version)

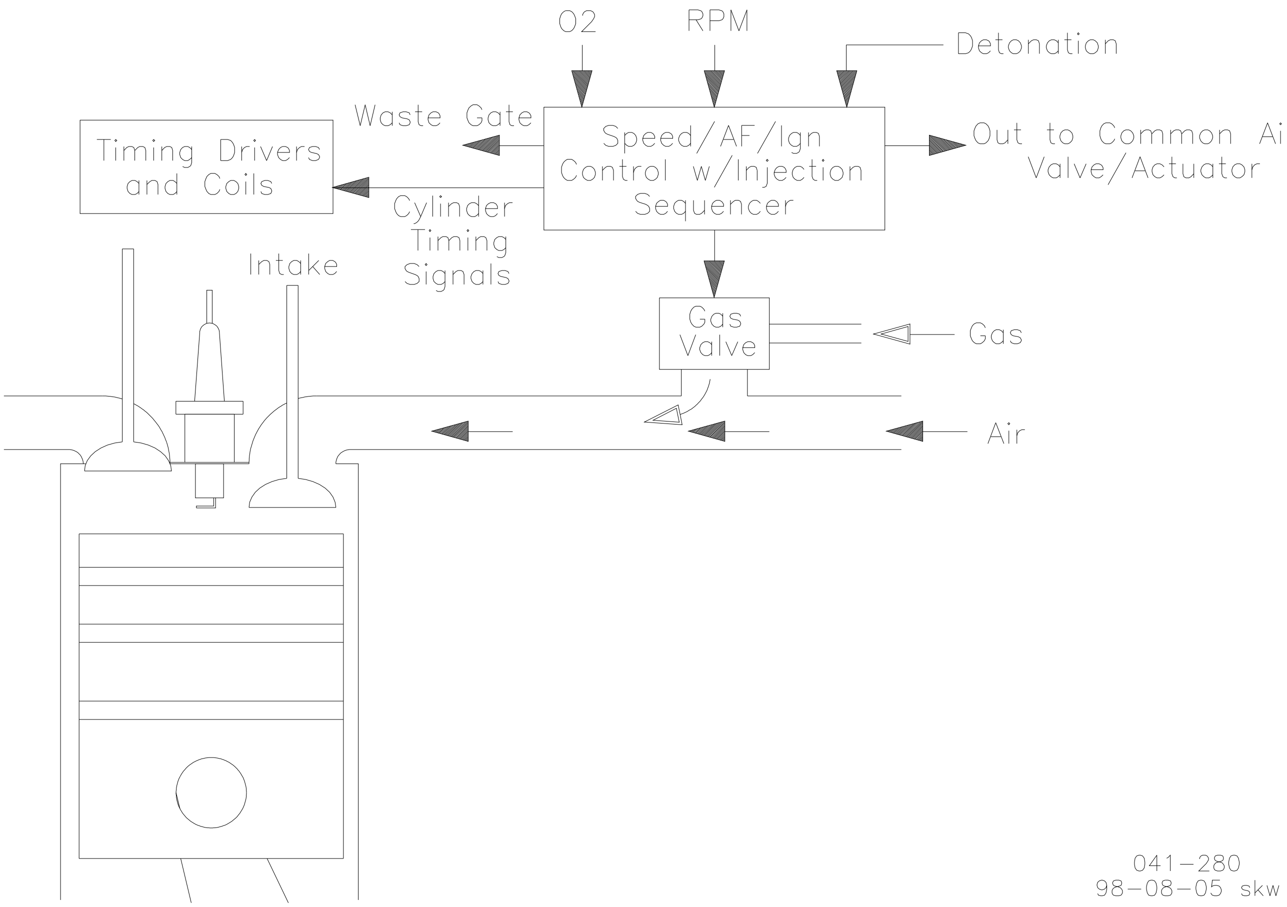


Figure 1-3. In-Manifold Electric Gas Admission

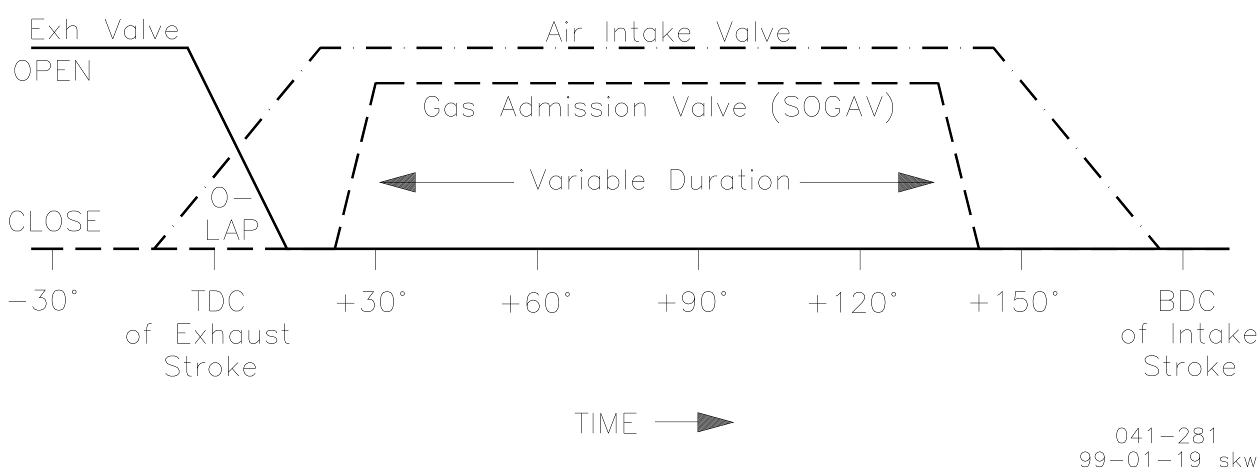


Figure 1-4. Timing: In-Manifold Gas Admission

Chapter 2. Installation/Adjustment

Installation

⚠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	**Due to typical noise levels in engine environments, hearing protection should be worn when working on or around the SOGAV 250.**

⚠WARNING	**The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.**

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

Refer to the outline drawings, Figures 1-1 and 1-2 (gland nut location and wire treatment vary depending on model).

It is imperative that the interior of all gas manifolding be absolutely clean prior to SOGAV installation and engine start-up. There must be no dirt, weld slag, metal chips, etc., present. Contamination of this type can prevent the valve from operating properly and can damage the engine if it passes through the valve.

The region around the SOGAV installation pad must also be very clean so that no debris gets into the air manifold during SOGAV installation.

Locate the appropriate O-ring (specified on the outline drawing) in the groove on the base of the SOGAV valve.

Mount the SOGAV valve to the cylinder head or air intake manifold runner using either M10 or 3/8-inch socket head screws. Socket head screws are required for bolt head clearance. Tighten these screws evenly to a torque recommended by the engine manufacturer.

Install the gas inlet line to the inlet side of the SOGAV valve using the O-ring specified on the outline drawing. Use M8x1.25 screws with at least 10 threads of engagement. Lubricate the threads and torque evenly to 20 N·m (175 lb-in).

If applicable, the cable connector should be installed last. Assure that the knurled locking nut is well snugged.

Connect the ground terminal on the SOGAV solenoid to earth ground.

Initial Operation/Adjustment

There are no field adjustments to be made to the SOGAV valve.

After installation, pressurize the gas manifold system (preferably with air or inert gas) and check for leaks around all valves and all interface flanges, by brushing on a soap and water solution.

Refer to the overall control system documentation for start-up/operation procedures. These procedures will vary from application to application.

If background noise is minimal, basic valve operation can be confirmed by an audible ticking sound.

Chapter 3. Application Guidelines

Introduction

Figure 1-4 shows the general timing relationships between exhaust valve position, intake valve position, and SOGAV valve opening.

This method allows for fresh air scavenging of the combustion chamber during the overlap period around TDC (top dead center) of the exhaust stroke.

After the overlap period (immediately after the exhaust valve closes), the SOGAV valve rapidly opens and admits gas into the air stream passing through the inlet runner. The gas is then carried into the combustion chamber with the air through the open air intake valve.

Governing is by duration. The SOGAV valve remains open for a duration necessary to keep the engine under speed or load control (by way of the electronic governor and In-Pulse unit).

The SOGAV valve must always close sufficiently before the air inlet valve closes in order to assure that all gas admitted into the inlet runner gets carried into the combustion chamber. If this time is not sufficient, gas will remain in the inlet runner after the intake valve closes and will pass through to the exhaust during the next overlap period (wasting fuel and emitting unburned hydrocarbons). It is the responsibility of the engineer applying the SOGAV system to determine the timing of SOGAV valve opening as well as the maximum allowable duration.

In the interest of maximizing the allowable duration and reducing the possibility of trapped gas in the runner after intake valve closing:
1. Locate the SOGAV valve as close as possible to the air intake valve, and
2. Minimize the length of the connecting passage between the SOGAV valve and the air manifold runner.

The SOGAV valve can be mounted in any orientation with the solenoid axis greater than horizontal, placing the solenoid higher than the metering plates. However, a vertical orientation (valve inlet facing upward) is preferred and will substantially increase valve life versus a horizontal orientation. Take care to keep the SOGAV valve and wiring from being exposed to extremely hot surfaces (such as exhaust systems).

The necessity for proper gas manifold design cannot be overstated. Ideally, the dynamic flow performance of the manifold design should be checked out using computer modeling before making hardware. After design and during developmental testing, the manifold should be instrumented and monitored in order to verify acceptability of the design.

The inside diameter of the gas feeder pipes connecting the SOGAV valves to the gas manifold must be the same size or greater than the gas inlet hole in the SOGAV valve. The inlet diameter of the valve is 94–96 mm. This pipe should be as short as possible. The length of this pipe affects the acceleration of the gas immediately after the valve opens. Increased opening duration is required to compensate for long feeder pipe lengths.

All gas feeder pipes must be the same length.

The feeder pipes connecting the gas manifold to the SOGAV valves must not impart substantial stress into the SOGAV valve when installed. Flexible lines are preferred to rigid steel welded assemblies.

The gas manifold should be sufficiently large so that:

1. Local pressure drops at the entries to the feeder pipes are minor (while the valve is at full flow), and
2. Pulsations are damped such that flow through the gas pressure regulating device is essentially steady.

It is best if the gas manifold is fed at multiple locations. The engineer designing the gas manifold must consider the effects of multiple valves being open at the same time. For example, a V-16 engine will often have three SOGAV valves open and flowing at the same time. If that engine were equipped with a common manifold fed at one end only, the farthest of the three valves could be starved because of pressure drops caused by the other two open valves.

The surface to which the valve mounts (intake manifold runner) must have an opening between 95–110 mm. (refer to the outline drawing, Figure 1-1). A smaller hole will restrict flow, and a larger hole would not allow for proper loading of the lower plate. The O-ring seating surface finish must meet industry standards for O-ring sealing with gasses.

Gas distribution (dispersion) devices in the air manifold runner might help to increase the homogeneity of the mix entering the combustion chamber. Before designing such a device, the engineer must consider that:

1. These devices restrict gas flow and can easily be more restrictive than the (wide open) SOGAV valve itself, and
2. These devices might not get well purged of gas during the period after the SOGAV valve closes and before the air intake valve closes. During the SOGAV valve 's closed period, this trapped gas may trickle out such that during the following overlap period, unburned gas passes through to the exhaust.

In addition to controlling gas admission events, the main engine controller must control air manifold pressure and gas manifold pressure.

Air manifold pressure control is required in order to achieve the desired air/fuel ratio. This can be done with an air throttle valve/actuator and/or a wastegate valve/actuator.

Gas manifold pressure regulation is necessary because:

1. Air manifold pressure varies significantly during operation,
2. The amount of fuel admitted per event varies significantly depending on speed and load, and
3. The unbalanced SOGAV 250 valve is limited to 150 kPa (1.5 bar) of pressure drop across it. Pressure drops greater than these limits will prevent the valve from opening.

If operating at a low load condition, a relatively small pressure drop is required to prevent extremely short durations. Extremely short durations are not desirable because they can reduce mixture homogeneity. Also, small unit-to-unit SOGAV response variations result in substantial unit-to-unit fuel admission variations when operating at extremely short durations. These response variations have a very minor effect when duration is relatively long.

If operating at full speed and full load, a fairly high pressure drop (150 kPa/1.5 bar) is generally required to admit the required amount of fuel in the time permitted. If the engine's load were substantially reduced without reducing the gas manifold pressure, a pressure drop greater than the 150 kPa/1.5 bar limit would exist across the valve and the valve would not function.

Gas pressure regulation must be handled by the main engine controller and is discussed here to assist in understanding how the overall system works.

Wiring

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

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

The wiring connecting the In-Pulse unit to the valves should be shielded, twin-lead wire with an insulation adequate for the on-engine environment. The shielding should be grounded through the In-Pulse connector, but not grounded on the SOGAV end.

The mating connector is defined on the outline drawing (Figure 1-1).

The cables do not need to all be the same length as long as each cable meets the electrical code requirements for the location of operation and the following length/wire gauge criteria:

- Up to 15 m cable length: 1 mm^2 (18 AWG) required
- 15 to 25 m cable length: 1.5 mm^2 (16 AWG) required
- 25 to 40 m cable length: 2 mm^2 (14 AWG) required

Connect the ground terminal on the SOGAV solenoid to earth ground.

The wiring connecting an LECM to the valves is not required to include shielding but must be twisted-pair wire with at least 30 twists/meter. The wire must have an insulation type adequate for the on-engine environment. The insulation diameter must be within the tolerance described in the LECM Hardware Installation Manual to properly seal at the LECM connector.

SOGAV applications utilizing the Woodward In-Pulse II controller or ECM3 controller should be set up such that the SOGAV cable shielding is not grounded to the SOGAV. The cable gland that holds and seals the cable relative to the SOGAV solenoid should therefore be the non-grounding style for these applications. Failure to comply with this requirement may cause controller and engine operational issues, and will invalidate the controller EMC certification(s). This requirement applies only to the controllers mentioned in this paragraph. Applications utilizing other controllers may be set up differently assuming they meet the necessary performance and EMC requirements.

SOGAV applications utilizing the Woodward LECM controller do not require shielded cable. However, if shielded wiring is desired and the total length from the SOGAV to the LECM is less than 10 meters, the shield should be terminated to the appropriate shield pin on the LECM connector. The cable gland that holds and seals the cable relative to the SOGAV solenoid may be either the non-grounding style or the grounding style. The grounding style is preferred. If the cable length is greater than 10 meters, do not connect the shield at the LECM. Use only a grounding-style cable gland at the SOGAV to terminate the shield instead.

Sizing

Always consult a Woodward application engineer to determine the appropriate system and hardware for the specific application.

For an indication of which SOGAV valve is most appropriate for an application, follow these steps:

1. Assuming the full speed and full load condition, determine the air manifold pressure required to achieve the desired air/fuel ratio. Call this variable P2 and use units of bar (absolute; 1 bar = 100 kPa).
2. Determine the properties of the poorest quality gas expected to be used on this application. In addition to energy content, the following properties are required:
   - Specific gravity relative to air. Call this variable sg (unitless).
   - Ratio of specific heats (c_p/c_v). Call this variable k (unitless).
3. Assuming the full speed and full load condition and the fuel energy content, determine the mass (in grams) of fuel required per combustion event.
4. Determine the maximum allowable SOGAV admission time duration per combustion event (in seconds). Subtract 0.005 seconds to compensate for SOGAV opening and closing times and for gas acceleration delay in the gas manifold runner. Consider the timing and duration issues discussed in the previous section.
5. Using the data from steps 3 and 4 above, determine the required mass flow rate while the valve is in the open condition. Call this variable MR and use units of grams/second.
6. Assuming use of the SOGAV 250 valve, calculate the available flow. Using a P1 (gas manifold pressure) of 1.5 bar greater than P2 , perform the Available Flow Rate calculation. Determine if the available flow (MA) exceeds the required flow (MR) calculated in step 5.

Available Flow Rate Equation:

$$Ma := Z\cdot\sqrt{\frac{k\cdot 2}{(k-1)}\cdot sg\cdot\left(P_1\right)^2\cdot\left[\frac{293.15}{\left(273.15+T_g\right)}\right]\cdot\left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}}-\left(\frac{P_2}{P_1}\right)^{\left(\frac{k+1}{k}\right)}\right]}$$

where:
Ma = available gas mass flow rate (g/s)
Z = valve constant (use 215 for SOGAV 250)
k = ratio of specific heats (Cp/Cv)
sg = gas specific gravity (relative to air)
P1 = gas absolute upstream pressure at valve entry (bar)
P2 = gas absolute downstream pressure at valve exit (bar)
Tg = gas temperature (°C)

The above equation is valid only for ratios of P2/P1 greater than 0.544. For P2/P1 ratios less than 0.544, flow is choked (sonic or critical). To make the equation valid for P2/P1 ratios less than 0.544, use P2/P1 = 0.544 instead.

For example, assuming the SOGAV 250 valve, k = 1.31, sg = 0.55, P1 = 4.5 bar, P2 = 3.0 bar, and Tg = 20 °C, steady state full open flow would be approximately 538 g/s.

Input Power Limitations

Woodward solenoids are labeled with maximum rated values of input current and input power. These input ratings must not be exceeded during continuous solenoid operation, to prevent exceeding a prescribed coil temperature rise at the maximum rated ambient operating temperature. These solenoids must be driven by specially designed current limiting drivers, providing periodic, two-tier current waveforms. Details on how to determine and interpret these values are in the Appendix.

Safety

In addition to normal safety systems used with gas engines, the gas manifold should be immediately de-pressurized and evacuated after engine shutdown. This is required to prevent possible leaks of gas into the air manifold (through the SOGAV valve) after shutdown. Gas leaks of this type can cause overfueling during the next start-up.

⚠WARNING	**If a leak is detected, immediately shut down the engine and purge the fuel system. Determine the source of the leak and correct the leak. If the source of the leak is the SOGAV, replace the faulty valve. Before restarting the engine, ensure there are no leaks and that the leak detection system is functioning properly.**

Chapter 4. Servicing

Service life of the SOGAV valve is highly dependent on the following variables, which are beyond the control of the manufacturer:

- Engine speed
- Fuel quality/contaminants
- Fuel filtration
- Temperature
- Vibration
- Driver electronics used
- Oil/lubrication content of fuel (2 ppm minimum oil content is recommended; for oil content less than 2 ppm, the appropriate coated version of the SOGAV should be used.)
- Valve orientation (a vertical orientation [valve inlet facing upward] is preferred)

Therefore, SOGAV valve maintenance/reconditioning should be carried out at intervals determined by the engine manufacturer for the particular application.

For optimum service/reconditioning, return SOGAV valves to Woodward, where trained personnel and sophisticated reconditioning and test equipment is available.

If on-site maintenance or troubleshooting is required, refer to Chapter 5.

Chapter 5.
Maintenance/Troubleshooting

Introduction

Some SOGAV valve troubleshooting and minor valve maintenance can be done in the field. However, the lack of flow and response testing facilities often limits the ability to analyze the problem and verify the solution. If time permits, it is always advisable to return the SOGAV valves to Woodward for service.

⚠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	**To prevent possible serious personal injury or damage to equipment, be sure all electric power and gas pressure have been removed from the SOGAV 250 and solenoid before beginning any maintenance or troubleshooting.**

⚠WARNING	**Maintenance and troubleshooting should only be attempted by properly trained personnel. Hazardous voltages are present during the troubleshooting procedure and present a risk of electric shock. Failure to observe these warnings could lead to injury or death.**

NOTICE	**Disassembly without prior Woodward authorization voids the manufacturer's warranty.**

Troubleshooting

If a SOGAV valve is suspected of having a problem, one of four tests will most likely isolate the problem. If the SOGAV valve passes the four tests, the problem is probably not with the SOGAV valve, and disassembly should not be required. The following tests assume that the valve has been removed from the engine. The tests should be done in the order listed.

⚠WARNING	**Prior to performing any maintenance on the SOGAV valve, remove all electrical power from the valve solenoid and relieve all gas pressure from the inlet and the outlet of the valve. Failure to remove all electrical power and relieve all inlet and outlet gas pressure before performing maintenance may result in equipment damage, personal injury, or death.**

Coil Integrity

1. Measure coil resistance from one connector pin to the other. At room temperature, the coil resistance should be within the following ranges:

SOGAV 250 / MS Connector	1.1–1.3 Ω
SOGAV 250 / Flying Lead	1.1–1.3 Ω (slight variations may occur due to various lead lengths)

   Because of the low resistance levels, make sure to compensate for the meter lead resistance. If outside of this tolerance, the E-core coil assembly should be replaced.

   Additional indication of a coil problem can be observed by comparing coil resistance of a suspect SOGAV valve to one that is known to be good. This is particularly helpful if the meter's accuracy at low resistances is questionable.

2. Check for a ground fault. Measure resistance from either pin to the E-core solenoid assembly housing. If a low resistance is measured, a ground fault exists and the E-core solenoid assembly should be replaced.

   Generally, a properly operating coil will measure infinite resistance to ground; however sometimes a high resistance will be measured at first (> 10 MΩ) and the reading will gradually increase until the meter reads infinite. This is not a problem. This is a result of the meter's charging of the coil's natural capacitance.

Valve Leakage

Install a pressurization adapter to the gas inlet using the appropriate O-ring.

Apply 150 kPa/1.5 bar (21.8 psig) of air pressure to the SOGAV inlet. In a quiet area, listen to the outlet of the SOGAV valve. If the leakage is inaudible or barely audible, the valve is OK. If the leakage is appreciable, either the valve plates are damaged or contamination is present between the valve plates. In either case, disassembly and corrective action is required.

If instrumentation is available, measure the leakage flow rate. Leakage should be less than 2.83 m^3/h (100 SCFH [standard cubic feet/hour]).

Actuator Strength

Apply 150 kPa/1.5 bar (21.8 psig) of air pressure to the inlet of the SOGAV valve as was done during the leakage test.

⚠WARNING	**ELECTRIC SHOCK HAZARD—Exercise care in using the power supply below. The voltage and current are sufficient to cause death or serious injury.**

Using a power supply capable of 16 A at 110 Vdc, set up as follows:

- current limit: 16 A (Do not use the E-core to set up this current limit.)
- voltage limit: > 110 Vdc

Install a switch between the power supply and SOGAV E-core solenoid assembly. Turn off the switch and turn on the power supply.

Turn the switch ON and then immediately OFF.

NOTICE

DO NOT LEAVE THE SOLENOID ASSEMBLY ENERGIZED WITH 16 A FOR MORE THAN 2 SECONDS. **The coil will overheat if left continually energized with 16 A for more than 2 seconds. Also, remember that two 1-second bursts in rapid succession are equivalent to one 2 second burst in terms of heat generation. Allow one minute cool down between bursts. (The coil does not overheat in operation because the In-Pulse driver limits the 16 A "on" time to a maximum of 0.0032 seconds per event. This is not possible using the manual switch method.)**

If a loud pop is heard (like a balloon bursting), the actuator strength is adequate.

If no loud pop is heard and the current was applied properly, the valve should be disassembled and evaluated. Most likely, one of three situations exist:

- The socket head cap screw connecting the armature to the moving metering plate is loose; or
- There is debris between the moving metering plate and the upper plate; or
- There is debris between the armature and the E-core solenoid assembly.

Valve Travel

In the absence of elaborate flow test apparatus, a fair check of flow capacity can be inferred from valve travel.

For Bottom-Load only: The gas outlet of the valve has a seat protruding past the valve housing face. When installed on-engine, the seat is compressed flush with the valve housing. The seat must be flush with the valve housing face prior to the valve travel inspection.

Reset the power supply used in the previous test to a 6 A current limit.

With no pressure applied to the SOGAV valve, *turn the switch ON and quickly reduce the current to 2 A* (the valve can be continually operated at 2 A without overheating).

Using a depth micrometer or dial indicator, measure the distance from the SOGAV valve's base flange down to the face of the moving metering plate. Then de-energize the solenoid assembly (turn switch OFF) and repeat the measurement. The difference in measurements (travel) should be 0.49 to 0.52 mm (0.0193 to 0.0205 inch).

The depth micrometer or dial indicator should have a stem with a diameter less than 3 mm. The lapped face of the moving metering plate can be accessed by inserting the stem through one of the outlet holes in the lower stop & metering plate. The stem must also pass through a face groove in the lower stop & metering plate and contact the face of the moving metering plate.

If the travel is less than 0.48 mm, debris is probably present between the moving metering plate and the upper plate or between the armature and E-core solenoid assembly. If the travel is greater than 0.52 mm, some wear probably exists and the valve should be disassembled and the parts evaluated.

Comments

If the SOGAV valve passes the tests above, there should be no reason to disassemble it. The problem most likely lies elsewhere. In addition to suspecting the electronic controls (outside the scope of this manual), the following possibilities should be considered:

- Does pressure difference (ΔP) across the valve exceed 150 kPa/1.5 bar? This will prevent valve pull-in.
- Are the cables and connectors in good condition? Each lead should have less than 0.4 Ω resistance. Have the cables been burnt? Are there intermittent connections at the connectors? Are the connectors tight?

Chapter 6.
Specifications

Construction

All parts exposed to the gas are resistant to corrosion and stress corrosion cracking (a problem associated with hydrogen sulfides, which are sometimes present in natural gas).

Environment

Operating Temperature:
–20 to +105 °C (–4 to +221 °F) (8402-249, 8402-251, 8402-259)
–20 to +95 °C (–4 to +203 °F) (8402-250, 8402-255)

Storage Temperature:
–40 to +70 °C (–40 to +158 °F)

Vibration:
Contact Woodward for vibration qualification data and analysis.

Operating Humidity:
≤ 85% relative humidity, non-condensing

Storage Humidity:
≤ 90% relative humidity, non-condensing

Humidity, Salt Spray, Pressure Wash Resistance, etc:
The unit withstands exposure to pressure washing, salt spray, etc., without adverse corrosion or infiltration.

Ingress Protection:
IP66

Maximum Altitude:
4000 m

Fuel Gas Specifications:
NG = Natural Gas
CMM = Coal Mine Ventilation Gas
CBM = Coal Bed Methane

Fuel Gas Specification

		Gas				
		NG	**CMM**	**CBM**	**Biogas**	**Associated Gas**
Lower heating value, min (LHV_V)	$MJ/N \cdot m^3$	24	17	24	17	24
Methane number, min (MN)		Engine specific	90	Engine specific	90	30
Methane content, min CH_4	Vol-%	60	50	60	50	40
Carbon dioxide, max CO_2	Vol-%	30	5	30	60	30
Carbon monoxide, max CO	Vol-%					
Hydrogen sulfide, max H_2S	Vol-%	0.05	0.05	0.05	0.05	0.05
Hydrogen, max H_2	Vol-%	5	5	5	5	5
Condensate / Moisture		Not allowed	Not allowed	Not allowed	Not allowed	Not allowed
Ammonia, max NH_4	$Mg/N \cdot m^3$	40	40	40	40	40
Chlorine + Fluorines, max	$Mg/N \cdot m^3$	60	60	60	60	60
Silicon, max	$Mg/N \cdot m^3$				50	
Particles or solids, max content	$Mg/N \cdot m^3$	50	50	50	50	50
Particles or solids, max size	µm	5	5	5	5	5

Certain chemicals, although not typically present in natural gas fuels, can damage the valve, potentially causing reduced functionality and/or fuel leakage to the environment.

It is the responsibility of the end user to verify the following chemicals are not present in the fuel:
- Acetone
- Ethyl Acetate
- Furfural
- Ethylene Dichloride
- Methyl Ethyl Ketone
- 2-Nitropropane

Performance

Response (assumes the use of a Woodward In-Pulse control)
Time to full open after signal on:
0.0050 second max
Time to full closed after signal off:
0.0050 second max

Steady State Flow Rate (with valve in full open condition)
See the flow equation defined previously in the sizing section.

Maximum Leakage When Closed
Less than 0.25% of the rated steady state flow rate (i.e., 0.25% of the flow calculated in Steady State Flow Rate above)

Filtration Required
5 µm absolute max particle size

Expected Maximum Gas Supply Pressure (P1) (not a limiting specification)
450 kPa/4.5 bar absolute (65.3 psi absolute)

Expected Maximum Air Manifold Pressure (P2) (not a limiting specification)
300 kPa/3.0 bar absolute (43.5 psi absolute)

Maximum Gas Manifold to Air Manifold Pressure Difference
(the limiting specification: P1 – P2)
150 kPa/1.5 bar (21.7 psi)

Maximum Backfire Pressure Spike (without back-flowing through valve)
50 kPa/0.5 bar (7 psi) above the current gas manifold pressure
Exceeding this by more than 2 bar (29 psi) may damage the valve.

Expected Maximum Gas Supply Temperature
80 °C (176 °F)

Chapter 7.
Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (**EngineHelpDesk@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

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

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

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized 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 current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- 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 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.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic 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.

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. 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 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's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- 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.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor 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 one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

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

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name ______________________

Site Location ______________________

Phone Number ______________________

Fax Number ______________________

Prime Mover Information

Manufacturer ______________________

Engine Model Number ______________________

Number of Cylinders ______________________

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) ______________________

Power Output Rating ______________________

Application (power generation, marine, etc.) ______________________

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter ______________________

Control Description or Governor Type ______________________

Serial Number ______________________

Control/Governor #2

Woodward Part Number & Rev. Letter ______________________

Control Description or Governor Type ______________________

Serial Number ______________________

Control/Governor #3

Woodward Part Number & Rev. Letter ______________________

Control Description or Governor Type ______________________

Serial Number ______________________

Symptoms

Description ______________________

____

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

Appendix. Interpreting Solenoid Ratings

Procedure for interpreting the “Equivalent Average Direct Current” (EADC) and “Equivalent Average Power” (EAP) ratings of Woodward Solenoids

Introduction

Woodward solenoids are labeled with maximum rated values of input current and input power. These input ratings must not be exceeded during continuous solenoid operation, to prevent exceeding a prescribed coil temperature rise at the maximum rated ambient operating temperature. These solenoids must be driven by specially designed current limiting drivers, providing periodic, two-tier current waveforms (see example waveform in Figure A-1).

The first tier is the relatively large “pull-in” current pulse. The second tier is the lesser “hold-in” current pulse. Solenoid applications vary in regard to the current waveform required to achieve the desired solenoid performance, considering the device being actuated by the solenoid, the frequency of solenoid operation, etc. The parameters “Equivalent Average Direct Current” (EADC) and “Equivalent Average Power” (EAP) are used as ratings for these solenoids to achieve a rating procedure that can be applied to varying solenoid applications.

Equivalent Average Direct Current (EADC)

Equivalent Average Direct Current (EADC) equates to the equivalent dc current (I) that can be continuously applied to a solenoid, having the highest expected coil resistance and operating at the maximum rated ambient temperature, while not exceeding the rated solenoid coil temperature rise. The EADC rating can be related to various periodic, two-tier solenoid current waveforms used to drive the solenoids.

The average area under an “I^2 vs. time” solenoid current waveform plot depicts the solenoid coil heating effect. If the area under the “I^2 vs. time” waveform of a two-tier current waveform is equal to, or less than, the rated EADC of the solenoid, the two-tier waveform is acceptable (it will not overheat the coil) if the solenoid is operated at maximum rated ambient temperature. This approach is applied, in detail, as follows:

1. A solenoid application is established and a suitable, worst case, two-tier current waveform is defined, in terms of the parameters defined in Figure A-1, that achieve the desired solenoid dynamic performance.

2. The current waveform parameters are applied to the EADC equation as shown in the example calculation of Figure A-1. The resulting calculated EADC value must not exceed the solenoid’s rated EADC value, indicated on the solenoid nameplate.

3. The above analysis must include the “worst case” operating condition, which is the highest expected “duty cycle” waveform. The highest “duty cycle” waveform is a waveform whereby the duration of the current “ON” time, relative to the total time between periodic current waveform cycles, is the greatest.

Equivalent Average Power (EAP)

While EADC, as discussed above, is the most accurate and preferred parameter for determining suitability of two-tier waveforms, Equivalent Average Power (EAP) is another parameter that defines solenoid input limitations.

Equivalent Average Power (EAP) equates to the equivalent input power that can be continuously applied to a respective solenoid, operating at the maximum rated ambient temperature, without overheating the solenoid coil. The EAP rating can be related to typical periodic two-tier solenoid current waveforms used to drive the solenoids.

The product of (average coil current)² and coil resistance (I^2R) describes the solenoid coil heating effect (input power). For a given set of conditions, if the EADC (amps) of a two-tier current waveform is known, and if the associated solenoid coil resistance Rc (ohms) is known, the associated EAP can be calculated by the relationship:

$$EAP = EADC^2 * Rc \text{ (watts)}$$

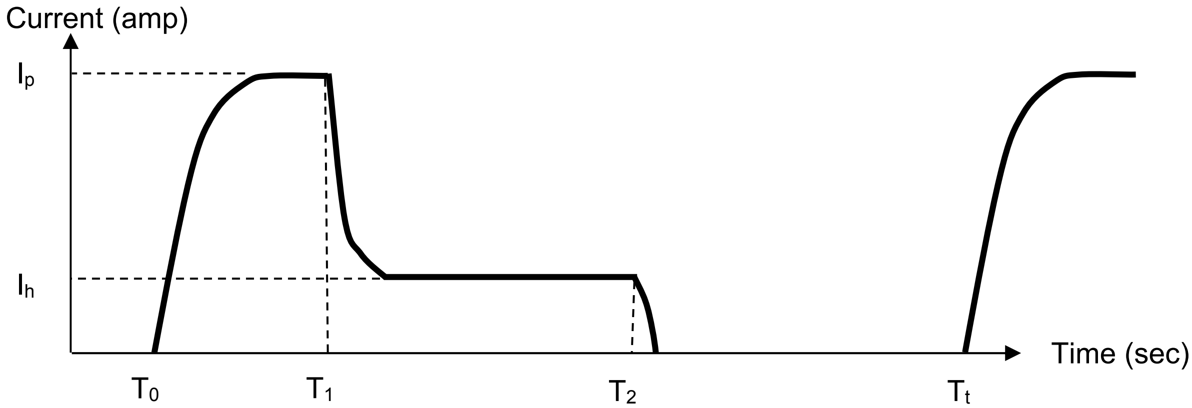
If the calculated EAP of a two-tier current waveform is equal to, or less than, the rated EAP of the solenoid, the two-tier waveform is acceptable in that it will not overheat the solenoid coil when operating at maximum rated ambient temperature. This approach is applied, in detail, as follows:

1. The value of EADC is calculated for a given two-tier current waveform as described above.

2. The highest expected nominal solenoid coil resistance (Rc max), for the object solenoid, at the rated coil temperature (including temperature rise) is determined from Table A-1.

3. Entering the calculated EADC value and listed coil resistance into the above equation will result in the EAP value for a given solenoid part number.

Two-Tier Solenoid Current Waveform



I_p = Pull-in Current
I_h = Hold-in Current
T_o = Initial Current Rise
T_1 = Initial Fall of Pull-in Current
T_2 = Initial Fall of Hold-in Current
T_t = Total Time of One Complete Current Waveform

Figure A-1. Two Tier Current Waveform Parameters

EXAMPLE CALCULATION—Equivalent Average Direct Current (EADC)

Let: T_o = 0.0 s I_p = 10 A
T_1 = 0.002 s I_h = 2 A
T_2 = 0.020 s
T_t = 0.100 s

EADC = [{(T₁ – T₀) * (Iₚ)² + (T₂ – T₁) * (Iₕ)²} / (Tₜ – T₀)] ⁰·⁵ (amps)

$$EADC = [\{(T_1 - T_0) * (I_p)^2 + (T_2 - T_1) * (I_h)^2\} / (T_t - T_0)]^{0.5} \text{ (amps)}$$

$$EADC = [\{(0.002 * (10)^2\} + \{0.018 * (2)^2\} / \{0.100\}]^{0.5} = [(0.2 + 0.072) / (0.100)]^{0.5}$$

EADC = 1.649 A

IMPORTANT

Due to assumptions of current waveform rise times, fall times, and other waveform parameters, the EADC value obtained from the equation shown above typically results in a conservative value. A more precise method may be used to calculate the EADC value of an application's current waveform if the method shown above results in an EADC value at or slightly over the solenoid's rated EADC value. Contact Woodward for more information or assistance if needed with EADC calculations for a particular application.

Solenoid Part No.	Coil Resistance (max) (ohms)
5852-125	1.91
5852-187	1.85
5852-253	1.91
5852-1006	1.91
5852-1008	1.91
5852-1062	1.91

Table A-1. Maximum Solenoid Coil Resistance (Rc) Values for Woodward SOGAV 250 Solenoids (at Max Rated Temperature)

IMPORTANT

Coil resistance values listed represent the expected coil resistance when the coil has reached its maximum allowed operating temperature. In each case, the resistance, at a coil temperature of 21 °C, is assumed to be the maximum value allowed by the coil design specification.

Revision History

Changes in Revision P—
- Revised SOGAV 250 Outline Drawings (Unbalanced/Top-Load)

Changes in Revision N—
- Added Unbalanced Top-Load version

Changes in Revision M—
- Clarified Valve Travel inspection (page 14)

Changes in Revision L—
- Updated ATEX information
- Updated Declarations

Changes in Revision K—
- Removed disassembly information, since field disassembly is not recommended

Declarations

DECLARATION OF CONFORMITY

DoC No.:	00147-04-CE-02-03
Manufacturer's Name:	Woodward, Inc.
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	SOGAV 105, SOGAV 250
Conformance to Directive(s): **The object of the declaration described above is in conformity with the following Directives of the European Parliament and of the Council:**	2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits. 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
Markings in addition to CE mark:	Ex Category 3 Group II G, Ex nA IIC T3 X Gc IP54
Applicable Standards:	EN61010-1:2010 – Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1:General requirements EN60079-15:2010 – Explosive atmospheres – Part 15: Equipment protection by type of protection n
Last two digits of the year in which the CE marking was affixed for the first time:	03

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

MANUFACTURER

Signature

Christopher Perkins
Full Name

Engineering Manager
Position

Woodward, Inc., Fort Collins, CO, USA
Place

14 May 2014
Date

5-09-1183 Rev 20

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

Manufacturer's Name:	Woodward, Inc.	
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525	3800 N. Wilson Ave. Loveland, CO, USA 80538
Model Names:	SOGAV 2.2, 36, 43, 65, 105, 200, 245, and 250	
This product complies, where applicable, with the following Essential Requirements of Annex I:	1.1, 1.2, 1.3, 1.4, 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 at Woodward Poland Sp. z o.o
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 Governor Company of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER

Signature

Christopher Perkins
Full Name

Engineering Manager
Position

Woodward, Inc., Fort Collins, CO, USA
Place

14 May 2014
Date

5-09-1182 (REV. 10) 00147-04-CE-02-02

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26114P.

B26114:P

WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, 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.