UL Listed GM-20/25 and GM-40/45 Series
Dual-block Multi-function Gas Control Valves

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Application</td>
<td>3</td>
</tr>
<tr>
<td>• Electrical Ratings</td>
<td>3</td>
</tr>
<tr>
<td>• Specifications</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Installation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mounting</td>
<td>5</td>
</tr>
<tr>
<td>• Wiring (From Burner Sequence Control)</td>
<td>6</td>
</tr>
<tr>
<td>• GM-4_6 Connection of Impulse Lines</td>
<td>7</td>
</tr>
<tr>
<td>• Checkout Procedure</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjustments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• GM-_ <em>1</em> (Dual On/Off Fast Open with Flow Adjustment)</td>
<td>9</td>
</tr>
<tr>
<td>• GM-_ <em>2</em> (Dual On/Off Step-slow Opening with Flow Adjustment)</td>
<td>10</td>
</tr>
<tr>
<td>• GM-_ <em>3</em> (Dual On/Off with Pressure Regulator)</td>
<td>10</td>
</tr>
<tr>
<td>• GM-_ <em>4</em> (Dual On/Off Step-slow Opening with Pressure Regulator)</td>
<td>11</td>
</tr>
<tr>
<td>• GM-4_5_ (Dual On/Off with Servo Precision Regulator)</td>
<td>11</td>
</tr>
<tr>
<td>• GM-4_6_ (Dual On/Off with Gas/Air Ratio Control)</td>
<td>12</td>
</tr>
</tbody>
</table>

| Repairs and Replacement | 15 |
Introduction

The UL Listed GM Series dual-block multi-function gas control valves are intended for use on atmospheric and forced-draft gas burners in heating installations. This multi-functional control on a dual-block valve body provides a compact answer to gas train applications. The GM valve replaces multiple gas train components, such as on/off gas valves, gas pressure regulators, and modulating gas valves. Optional sizing of body flanges offers greater adaptation to diversified burner designs and applications. Valves are approved to European and North American gas valve standards, including UL 429.

Typical applications include boilers, burners and ovens, rooftop units, makeup air heaters, hot water heaters, kilns, and paint booths.

<table>
<thead>
<tr>
<th>Valve Model</th>
<th>Operating Voltages</th>
<th>Power Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM-2__ __</td>
<td>230 VAC +10/-15%, 50/60 Hz 120 VAC +10/-15%, 50/60 Hz 24 VAC +10/-15%, 50/60 Hz</td>
<td>46 VA</td>
</tr>
<tr>
<td>GM-4__ __</td>
<td>230 VAC +10/-15%, 50/60 Hz 120 VAC +10/-15%, 50/60 Hz 24 VAC +10/-15%, 50/60 Hz</td>
<td>46 VA</td>
</tr>
</tbody>
</table>
Table 2: Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>1st (Manufactured Gas), 2nd (Natural Gas), and 3rd (Liquefied Petroleum [LP] Gas) Family Gases</th>
</tr>
</thead>
</table>
| **Maximum Inlet Pressure**              | **Europe:**
|                                         | GM-01 and GM-02: 360 mbar
|                                         | GM-251 and GM-252: 200 mbar
|                                         | All Other Models 100 mbar
| **North America:**
|                                         | GM-01 and GM-02: 5 psi
|                                         | GM-251 and GM-252: 2 psi
|                                         | All Other Models 0.5 psi
| **Maximum Regulating Setting**          | 20 mbar (8 in. W.C.) (GM-__3_ and GM-__4_)
|                                         | 50 mbar (20 in. W.C.) (GM-4_5_ and GM-4_6_)
| **Reverse Pressure Rating**             | 150 mbar (60 in. W.C.) minimum; Class A (EN 161)
| **Regulator Classification**            | Spring Regulator (GM-__3_ and GM-__4_): Class B (EN 88)
|                                         | Servo Regulator (GM-4_5_): Class A (EN 88)
| **Permissible Ambient Temperature**     | -15 to 60°C (5 to 140°F)
| **Body Connections**                    | Detachable flanges with pipe thread 3/8 to 1-1/2 in. NPT
| **Valve Torsion Group**                 | Group 2 (EN 88 and EN 161)
| **Pressure Taps**                       | Flanges: Rp 1/8 blank plug
|                                         | Body: Rp 1/8 thread standard (multi-position)
|                                         | Rp 1/4 thread special (multi-position) GM-4 only
| **Materials**                           | Body and Flanges: Die-cast aluminum
|                                         | Diaphragms and Seals: Perbunan rubber
|                                         | Solenoid Enclosure: IEC 529 (NEMA 1 and IP 54)
| **Filter Segment**                      | Standard Dirt Strainer: 0.5 mm (0.02 in.) metal mesh
|                                         | Optional Filter Set: 0.05 mm (0.002 in.) nylon mesh and fleece filter
| **Operating Time Rating**               | 100% Continuous
| **Valve Timings**                       | Closing Time: < 1 second
|                                         | Opening Time: < 1 to 15 seconds
|                                         | Dead Time: < 1 second
| **Electrical Connections**              | 1/2 in. NPT conduit adapter compression fitting with cage-type terminal blocks inside the electrical box
| **Coil Insulation Class**               | Class F
| **Agency Listings**                     | IAS (AGA/CGA) Certificate Numbers: C0197002, C0197004
|                                         | European Certificate Number: CE 0063AN3731
|                                         | UL Listed File Number: MH25441 (Guide YIOZ)
| **Specification Standards**             | EN 88, EN 126, and EN 161
|                                         | Standards Complying with the EMC Directive
|                                         | Standards Complying with the Low Voltage Directive
|                                         | ANSI Standards, Z21.18, Z21.21, and Z21.78
|                                         | Canadian Standards CAN1-6.3 and CAN1-6.5
|                                         | UL Standard 429

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damage resulting from misapplication or misuse of its products.

Refer to the GM-20/25 and GM-40/45 Series Product Bulletin (LIT-4350340) for necessary information on operating and performance specifications of this product.
Installation

Mounting

IMPORTANT: This technical bulletin is intended as a guide for authorized service personnel installing or servicing Johnson Controls products. Carefully follow all instructions in this sheet and all instructions on the appliance. Limit repairs, adjustments, and servicing to the operations listed in this sheet or on the appliance.

! WARNING: The system must meet all applicable codes. Improper installation may cause fire, explosions, property damage, and injuries or death.

Carefully follow all instructions in this sheet and all instructions on the appliance. Limit repairs, adjustments, and servicing to the operations listed in this sheet or on the appliance.

! WARNING: Fire or explosion hazard. Shut off the gas supply at the main manual shutoff valve before installing or servicing the GM Series valve.

1. Ensure that the maximum ambient temperature is not exceeded (see Table 2).
2. Check the power supply voltage for compatibility with the required valve voltage. All wiring must conform to national and local electrical codes and regulations.
3. When installing the valve on the manifold, the gas must flow through the valve body in the direction indicated by the arrow on the body. If the valve is installed with the gas flow opposite the arrow, leakage can occur.
4. Shut off the gas at the main manual shutoff valve.
5. Mount the valve. It is recommended that the flanges be mounted to the pipe separately with the valve then mounted between the two flanges. The filter plate assembly should be installed (using the longer bolts) between the inlet flange and the valve.
The GM Series valve may be mounted on a horizontal manifold with the solenoid actuator pointed up (vertical) or in any position not exceeding 90° from the vertical. The valve may also be mounted on a vertical manifold in any position around its axis (see Figure 2). Do not install the solenoid actuator upside down. Install vertically wherever possible.

Figure 2: GM Series Valve Mounting Position

Use an approved pipe joint sealing compound on male threads before assembly.

6. Remove excess compound after mounting the flanges to the pipe. Threads of pipe and nipples must be smooth and free of tears and burrs. Steam clean all piping to remove foreign substances such as cutting oil or thread chips.

WARNING: Shock hazard. Avoid electrical shock and equipment damage by disconnecting electrical power to the valve before proceeding.

CAUTION: Equipment damage hazard. To prevent possible grounding of the 24 VAC transformer secondary, do not connect the ground wire on 24 VAC models.

Follow the procedure below to wire the valve.

1. Observe that the operating voltage is identical to the information on the product identification label.

2. Connect conduit from the burner sequence control to each valve solenoid electrical box 1/2 in. NPT conduit adapter.

3. Remove the cover of each electrical box and make wiring connections in accordance with Figure 3.

4. Reattach electrical box covers.
The internal diameter of the impulse tubes for the combustion air ($P_a$) and the combustion chamber pressure ($P_f$) should be 4.0 mm (5/32 in.), see Figure 4. Make the connections as short as possible and route to prevent the entry of condensate into the controller. The installation of a condensation trap in the connection line from the combustion chamber is highly recommended. Do not close the connection for $P_f$ if not used.

**IMPORTANT:** Avoid sharp bends or kinks in the tubing to avoid damage to the tubing and allow for an accurate pressure reading.

**Figure 4: Impulse Line Connections**
**WARNING:** **Fire or explosion hazard.** Verify that the valve functions properly and there are no gas leaks. Follow this checkout procedure before leaving the installation. Failure to verify proper valve installation, equipment operation, and gas tight connections may result in fire, explosion, property damage, and injuries or death.

1. Shut off the gas at the main manual shutoff valve and open the pressure connection between the manual shutoff valve and the GM valve.
2. Connect air tubing with a maximum of 70 mbar (1 psi) pressure to the opened pressure connection.
3. Paint the pipe connections and flanges of the valve with a rich soap and water solution (or use acceptable gas leak detection equipment) to check for leakage.
   
   If bubbles occur, this is an indication of a leak. To stop a leak, tighten joints and pipe connections. Replace the part if the leak cannot be stopped.
   
   If bubbles do not occur, remove the air tubing and close the upstream pressure connection.
4. Open the main manual shutoff valve.
5. Refer to the *Adjustments* section to make any necessary valve setting adjustments.

**WARNING:** **Fire or explosion hazard.** Valve settings must be in accordance with the appliance or equipment manufacturer’s specifications.

6. Before leaving the installation, observe at least three complete operating cycles to ensure that all components are functioning correctly.
Adjustments

IMPORTANT: All adjustments must be made in conjunction with the gas appliance and in accordance with the appliance manufacturer’s instructions. Only authorized personnel should make adjustments. See each valve model version for specific adjustments.

WARNING: Explosion hazard. The minimum flow rate of the valve must not be adjusted below the minimum safe working rate of the appliance.

It is recommended that pressure connections be used to monitor the inlet and outlet valve pressure while performing each of the specific adjustment procedures.

This valve provides manual flow adjustment throughout the full range of zero to maximum flow. For flow rate adjustment, loosen the unsealed mounting screw on the plastic adjustment knob at the top of the solenoid coil. Hand turn the adjustment knob clockwise to decrease or counterclockwise to increase the flow rate through the valve (see Figure 5). Tighten the mounting screw to secure the adjustment knob at the desired flow rate.

Figure 5: Manual Flow Adjustment Knob
This valve provides adjustable step/slow opening for smooth ignition in a burner application. The valve is factory set to maximum start gas position and maximum flow position. Adjust the hydraulic damper at the top of the solenoid coil to set the desired flow rate through the valve as well as the desired start gas flow rate.

To adjust the maximum flow rate, loosen the unsealed mounting screw on the aluminum hydraulic damper housing. Hand turn the housing clockwise until the desired setting is obtained. Tighten the mounting screw to secure the adjustment knob at the desired flow rate.

To adjust the start gas position, remove the plastic cap from the hydraulic damper housing and turn the brass screw clockwise until the desired setting is obtained (see Figure 6). Replace the plastic cap.

![Figure 6: Hydraulic Damper Housing](image)

This valve provides spring regulation to maintain the gas pressure at the valve outlet. For outlet pressure adjustment, loosen the unsealed mounting screw on the plastic regulator knob at the top of the solenoid coil. Hand turn the regulator knob clockwise to increase or counterclockwise to decrease the outlet pressure of the valve (see Figure 7). Tighten the mounting screw to secure the adjustment knob at the desired outlet pressure.

![Figure 7: Spring Pressure Regulator Adjustment Knob](image)
This valve provides controls for step/slow opening (for smooth ignition) and pressure regulation (for maintaining outlet gas pressure).

Refer to the GM-__3__ version for setting the gas pressure at the valve outlet. For setting of the start gas position and maximum flow rate, see the GM-__2__ version.

This valve provides servo regulation for precision control of the valve outlet pressure. To set the valve for the desired outlet pressure, the start gas pressure must be adjusted first.

To set the start gas position, energize the solenoid coil to open the valve seats. Remove the pressure tap plug (see Figure 8) located below the gas outlet pipe connection and measure the start gas pressure. The adjustment scale (PST) indicates the factory-set start gas pressure (see Figure 9); therefore, a subsequent fine adjustment may be necessary. Use the hexagonal tool provided (or an acceptable Allen wrench) to adjust the PST scale and obtain the desired start gas pressure.
The start gas pressure ($P_{st}$) remains at the set level until the pressure tap plug is replaced and tightened. The pressure then rises to the setpoint ($P_g$).

**IMPORTANT:** $P_g$ must be greater than $P_{st}$ in order for the valve to operate properly.

Once the desired start gas pressure has been obtained, the outlet pressure ($P_g$) can be adjusted. To set the outlet pressure position, energize the solenoid coil to open the valve seats. Remove an outlet pressure tap plug from the valve body and measure the servo pressure regulator performance and timing characteristics (see Figure 10). The adjustment scale ($P_g$) indicates the factory-set outlet pressure (see Figure 9), which can be adjusted using the hexagonal tool provided (or an acceptable Allen wrench) to obtain the desired servo pressure regulator performance and timing characteristics.

![Figure 10: Servo Pressure Regulator Performance vs. Timing Characteristics](image)

Cycle the valve three times to check for proper performance, leaving a minimum time of 20 seconds between cycles to evacuate the pressure chamber.

This valve provides mechanical modulating control of the gas outlet pressure at a consistent ratio to the main air blower pressure. An example of a typical installation is shown in Figure 11. The burner control responds to a higher demand for heat by increasing the amount of air being supplied to the burner, resulting in an increased air pressure. With the air pressure ($P_a$) connected to the valve, the valve seat position is controlled to achieve the optimum outlet gas pressure according to the preset gas/air ratio.
The combustion chamber pressure ($P_F$) can be connected to improve combustion quality in cases where the combustion chamber pressure is significantly higher during operation than atmospheric pressure.

The valve not only allows a gas/air ratio adjustment, but also an offset adjustment (zero set), which allows for fine adjustment at lower ratios. With these adjustments, the outlet valve pressure ($P_G$) calculates to:

$$P_G = R \cdot P_A + Z$$  without combustion chamber pressure $P_F$

$$P_G - P_F = R \cdot (P_A - P_F) + Z$$  with combustion chamber pressure $P_F$

To adjust the valve, first check the factory settings. The adjustments for the gas/air ratio ($R$ scale) and zero set ($Z$ scale) are located on both sides of the gas/air ratio control module (see Figure 12). The factory settings are:

- Gas/air ratio ($R$): 1:2
- Zero set ($Z$): 0

Before starting the burner, make sure that the gas/air ratio and zero set settings are correct for the specific appliance. If necessary, use the hexagonal tool provided (or an acceptable Allen wrench) to adjust these settings to the appliance manufacturer’s recommendations. If the specific ratio settings are not available, ensure that the appliance is safe to operate at the factory settings.
Start the burner and gradually increase the output of the valve. If the burner does not light, check for a flame during the ignition phase. If the flame extinguishes immediately, the system may have excess air. Check again and adjust the gas/air ratio (R) setting if necessary.

With the burner in the maximum output position, adjust the gas/air ratio (R scale) to meet the desired flue gas analysis readings. The ratio (R) of gas outlet pressure ($P_g$) to combustion air pressure ($P_a$) is adjustable within a range of 0.6:1 to 6:1 (see Figure 13).

$$\frac{P_g}{P_a}$$

![Figure 13: Analyses Chart](image)

Check the flue gas analyses on low and high output settings without manipulating the adjustments. Once the readings have been checked, fine tune (by adjusting the zero set) the settings if necessary. In cases where combustion chamber pressure ($P_c$) is used, connect it and repeat the gas/air ratio (R) adjustment.

With the correct gas/air ratio (R) set, there may be some minor deviations (caused by friction, etc.) at very low pressures. To allow for fine adjustment of the valve, the zero set can be changed. The zero set adds a constant offset to the flue gas analyses, affecting the low output figures more significantly than the high output figures.

Zero set (Z) can be accomplished by a parallel shift of the characteristic curve from -2 to +2 mbar (-0.8 to +0.8 in. W.C.) (see Figure 13).

Set the burner to the low fire position, perform a flue gas analysis, and vary the outlet pressure by adjusting the Z scale until the desired flue gas analysis readings are obtained.

If adjusting the zero set (Z) results in an unacceptable high output figure, repeat the adjustments starting with the gas/air ratio (R) adjustment procedure.
Repairs and Replacement

Field repairs must not be made, except to replace the filter or strainer. For a replacement part, contact the nearest Johnson Controls representative or the original equipment manufacturer.

⚠️ CAUTION: Label all wires prior to disconnection when servicing valves. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

Perform the following steps to replace the filter or strainer.

1. Clean or replace the filter or strainer with each recommended inspection or at a minimum each annual functional inspection.

2. Close the main manual shutoff valve and disconnect field wiring. As each wire is disconnected, label it with the correct terminal designation.

3. Remove the screws on the flanges and remove the valve and filter plate.

4. Clean or replace the filter or strainer. Reinstall the filter plate and valve.

5. Refasten the flange screws to the valve and reconnect field wiring.

⚠️ WARNING: Fire or explosion hazard. Verify that the valve functions properly and there are no gas leaks. Follow this checkout procedure before leaving the installation. Failure to verify proper valve installation, equipment operation, and gas tight connections may result in fire, explosion, property damage, and injuries or death.

6. Open the pressure connection between the manual shutoff valve and the GM valve.

7. Connect air tubing with a maximum pressure of 1-1/2 times the valve’s maximum operating pressure (as indicated on the valve) to the opened pressure connection.
8. Paint the pipe connections and flanges of the valve with a rich soap and water solution.
   If bubbles occur, this is an indication of a leak. To stop a leak, tighten joints and pipe connections. Replace the part if the leak cannot be stopped.
   If bubbles do not occur, remove the air tubing and close the upstream pressure connection.

9. Open the main manual shutoff valve.

10. Observe at least three complete operating cycles to ensure that all components are functioning correctly.