APPLICATION

The CS4790/CS8790 Venturi Mixing Unit and Servo Regulated Gas Valve, with an application-specific DC fan, is used for modulating premix appliances such as gas burners, gas boilers, rooftop units, makeup air units and process applications.

FEATURES

- Wide modulation range (14% to 100% of burner load).
- 24 Vac and 120 Vac models.
- Main valve body with two shutoff seats (double block valve).
- Closing time < one second.
- Mesh screen (strainer) between inlet flange and main body.
- Various pressure tap points available at main body when no additional valves or pressure switches are used.
- DIN 43650 Plug Connector with 36 inch leadwires included.
- Flexible mounting positions of venturi manifold to fan.
- Four sizes available.
- Maximum operating pressure 1.45 psi (100 mBar).
- Replaceable pipe flange adapters available.
- Position indication lamp for each valve stage.

SPECIFICATIONS

The specifications in this section are related to the Venturi Mixing Unit and Combination Gas Valve.

Maximum Operating Pressure (UL): 
1.45 psi (100 mBar); except for 1-1/4 in. size (24V): 1 psi (70 mbar). 
CSA Approved: 0.5 psi (34 mBar).

Connections: 
1/8 in. (3 mm) NPT pressure taps at inlet and outlet flanges. 
Eight flange connections are provided at the main body to mount either a pressure switch (low or high) or a Valve Proving System (VPS).

Torsion and Bending Stress: Pipe connections meet EN161, Group 2, requirements.

Electrical Equipment: Dc coils with combined rectifier inside the cover.

Electrical Connection: Standard DIN plug connector with 36 in. (914 mm) leadwires, included.

Ambient Temperature Range: 5°F to 140°F (-15°C to +60°C).

Coil Insulation Solenoid Valves: Class H insulation system.

Body Material: Aluminum alloy, die cast.

Strainer: 
Fine mesh screen (.0135 in. [0.34 mm] diameter), AISI 303 steel, serviceable after removing inlet flange screws. Meets EN 161 requirements for strainers.

Models: 
See Table 1.
Table 1. Model Information.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Pipe Size NPT</th>
<th>Voltage/Frequency</th>
<th>V1 + V2 total Current</th>
<th>Capacity (Natural gas, 0.64 sp gr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS4790A1002</td>
<td>1/2 in.</td>
<td>120 Vac, 50/60 Hz</td>
<td>0.32 A</td>
<td>22-150 kW (73-512 kBTUH)</td>
</tr>
<tr>
<td>CS4790A1010</td>
<td>3/4 in.</td>
<td></td>
<td></td>
<td>43-300 kW (146-1024 kBTUH)</td>
</tr>
<tr>
<td>CS4790A1028</td>
<td>1 in.</td>
<td></td>
<td>0.50A</td>
<td>71-500 kW (245-1710 kBTUH)</td>
</tr>
<tr>
<td>CS4790A1036</td>
<td>1-1/4 in.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS8790A1008</td>
<td>1/2 in.</td>
<td>24 Vac, 50/60 Hz</td>
<td>1.56A</td>
<td>22-150 kW (73-512 kBTUH)</td>
</tr>
<tr>
<td>CS8790A1016</td>
<td>3/4 in.</td>
<td></td>
<td></td>
<td>43-300 kW (146-1024 kBTUH)</td>
</tr>
<tr>
<td>CS8790A1024</td>
<td>1 in.</td>
<td></td>
<td>1.72A</td>
<td>71-500 kW (245-1710 kBTUH)</td>
</tr>
<tr>
<td>CS8790A1032</td>
<td>1-1/4 in.</td>
<td></td>
<td></td>
<td>55-382 kW (185-1300 kBTUH)</td>
</tr>
<tr>
<td>CS8790A1040</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions:
See Fig. 1 through 5.

Fig. 1. CS4790/CS8790 Gas Valves, 1/2 in. and 3/4 in. size, dimensions in in. (mm).

Seals and Gaskets: Hydrocarbon resistant NBR and Viton rubber types.

Flange Kit: Consists of one flange with sealing plug, one O-ring and four screws. See Table 2.

Table 2. Flange Kits.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Size NPT in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>32006652-001</td>
<td>1/2</td>
</tr>
<tr>
<td>32006652-002</td>
<td>3/4</td>
</tr>
<tr>
<td>32006652-003</td>
<td>1</td>
</tr>
<tr>
<td>32006652-004</td>
<td>1-1/4</td>
</tr>
</tbody>
</table>

Fig. 2. CS4790/CS8790 Gas Valves, 1 in. and 1-1/4 in. size, dimensions in in. (mm).
Fig. 3. Venturi, 150-335 Kw, with 1/2 in. to 1 in. gas valves installed, dimensions in in. (mm). See Table 3 for dimensions.

Table 3. Dimensions in inches (millimeters).

<table>
<thead>
<tr>
<th>Valve Size in inches</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2, 3/4</td>
<td>6-1/4 (159)</td>
<td>10-11/32 (263)</td>
<td>2-15/16 (75)</td>
<td>7-1/2 (191)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>8-5/16 (211)</td>
<td></td>
</tr>
</tbody>
</table>

**Opening Time:**
Dead time maximum: 1 second.
First valve opening: < 1 second.
Second valve opening: reaches 50% of the adjustable outlet pressure within 5 seconds.

**Maximum Allowable Leakage:**
Outerwall: 3 cu. in./hr (50 cm³/h) at test pressure of 0.087 psi (6 mbar) and 7.83 psi (540 mbar).
Valve Seat: See Table 4.

**High Pressure Test:** In the Off condition, the valve will withstand 21.75 psi (1.5 bar) inlet pressure without damage.

**NOTE:** Attempts to operate the valve while in this condition will not cause damage.

**Closing Time:** Less than 1 second for all valves.

**Maximum Working Frequency:** One cycle per minute.

**Duty Cycle:** Coil suitable for permanent energizing in cooperation with ignition controller.

**Valve Position Indicator Lamps:**
Inboard (Closest to valve body): V1.
Outboard: V2.
Fig. 4. Venturi, 500 kW, with 1-1/4 in. gas valve installed, dimensions in in. (mm), part 1.
Fig. 5. Venturi, 500 kW, with 1-1/4 in. gas valve installed, dimensions in in. (mm), part 2.

**Accessories:**
- FL020008 Mesh screen.
- Flange Kits (see Table 2).
- DIN 43650 Connector.
- 32006653-001 Venturi O-rings/screws.
- 50002653-001 Manual Shutoff Valve Kit for 1 in. and smaller valve sizes.
- 50002653-002 Manual Shutoff Valve Kit for 1-1/4 in. valve.

**NOTE:** If manual shutoff valve is used, longer sensing tube must be ordered separately:
- KTTBA001 Sensing Tube for VMU 150/300/335 kW Venturi Mixing Units (VMU)
- KTTBA002 Sensing Tube for VMU 500 kW Venturi Mixing Unit.

**Operational Voltage Range:** The combination gas valve will function satisfactorily between 85% and 110% of the rated voltage.

**Gas Valve Connection to Venturi (Factory Assembled):**
- Four screws and an O-ring are used to connect the gas valve to the venturi.
- The metal tube provided with the venturi must be connected between the venturi and the gas valve regulator.

**Fan Connection:**
- The venturi is connected to the fan using six bolts (obtained separately).

**Minimum Load:**
- The minimum load for which the system can be used is 14-17% of the reference load, which equals a minimum pressure differential of 0.2 in wc (50 Pa) of the 1:1 venturi/servo regulator gas control.

**Approvals:**
- Gas Appliance Directive 90.396/EEC.
- PIN: 0063AT1198.
- Low Voltage Directive: 73/23/EEC.
- Electro Magnetic Compatibility Directive: 89/336/EEC.
- CSA: File Number 158158-1227192.
- Underwriters Laboratories, Inc. (UL): MH18476.
Capacity Curves:
See Fig. 6 through 9.

Fig. 6. Capacity curves for CS4790/CS8790, 1/2 in. size.

Fig. 7. Capacity curves for CS4790/CS8790, 3/4 in. size.
Fig. 8. Capacity curves for CS4790/CS8790, 1 in. size.

Fig. 9. Capacity curves for CS4790/CS8790, 1-1/4 in. size.
INSTALLATION

When Installing this Product...
1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. The installer must be a trained, experienced flame safeguard technician.
4. After installation is complete, check out product operation as provided in these instructions.

WARNING
Fire or Explosion Hazard.
Can cause serious injury, death or property damage.
1. Turn off the gas supply before beginning installation.
2. Disconnect power supply to the valve actuator before beginning installation to prevent electrical shock and damage to the equipment.
3. Do not remove the seal over the valve inlet and outlet until ready to connect piping.
4. The valve must be installed so that the arrow on the valve points in the direction of the gas flow, so that gas pressure helps to close the valve.

Mounting Position
The valve/venturi is factory calibrated in the upright position for the most accurate metering of the gas flow. This is with the air flow through the venturi in a horizontal direction and the gas flow into the valve in a horizontal direction. The valve can be mounted up to ±90 degrees from this position without affecting the fuel/air metering at medium and high firing rates (3000 to 5000 rpm of the blower), but at low firing rates (1000 rpm) the fuel may be reduced up to 10% when the valve is not mounted upright.

To counter this, the low fire gas flow may be carefully field adjusted for non-upright mounting as follows:
1. With the valve in the final mounting position, adjust the venturi fan for the lowest burner firing rate.
2. Remove the slotted cap on the gas regulator using a slotted screwdriver. This will expose the offset adjustment screw (See Fig. 10).
3. Using a TORX® T40 or a 5 mm hex wrench, carefully adjust the low fire gas setting for proper combustion.
4. After proper low fire offset adjustment has been made, reinstall the slotted cap on the regulator.
5. Before commissioning the burner, check for proper lightoff and verify correct fuel/air mix and combustion quality throughout the entire firing range (from lowest to highest fan speeds used).

Mounting locations
The distance between the gas valve and the wall/ground must be a minimum of 11-5/16 in. (30 cm).
Main Gas Connection

1. Take care that dirt does not enter the gas valve during handling.
2. Remove the flanges from the valves.
3. Use new, properly reamed, pipe, free from chips.
4. Apply a moderate amount of good quality pipe dope, resistant to the action of liquid propane (LP) gas, only on the pipe threads.
5. Screw the flange onto the pipes.
6. Do not thread pipe too far into flange. Valve distortion or malfunction can result from excess pipe in the flange.
7. Make sure O-ring sealing surfaces are clean.
8. Using general purpose lithium grease, grease the O-ring.
9. Install the O-ring in the O-ring grooves provided on the valve bodies (one O-ring per groove).
10. Mount the gas valve to the flange, using the screws removed earlier.
11. Complete the electrical connections as instructed in the Electrical Connection section.

**WARNING**

Fire or Explosion Hazard. Can cause property damage, severe injury or death. Perform a soap and water solution leak test any time work is done on a gas system.

Electrical Connections

**WARNING**

Electrical Shock Hazard. Can cause serious injury or death. Disconnect the power supply before beginning wiring to prevent electrical shock.

Wiring

1. Use 14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire for line voltage connections. Recommended wire types are TTW60C, THW75C or THHN90C.
2. Follow the instructions below for wiring the gas valve. See Fig. 11 and 12 for reference.
   a. T1 (yellow) will be L2 (120 Vac or 24 Vac).
   b. T2 (black) will be L1 (120 vac or 24 Vac) to Valve 1.
   c. T3 (blue) will be L1 (120 Vac or 24 Vac) to Valve 2.
   d. Ground (green) will be earth ground.

**ADJUSTMENTS AND FINAL CHECKOUT**

The following procedures are related to the adjustments on the main gas valve. For adjustment of the other devices (i.e., pressure switches), refer to the instructions supplied with the applicable device.

**WARNING**

Fire or Explosion Hazard. Can cause serious injury, death or property damage. Only fully qualified, experienced flame safeguard technicians should make adjustments on the valve.
Pressure Tap Points (Fig. 13)
The CS4790A/CS8790A have a number of connection points (1/8 in. [3 mm] NPT plugs) for measuring pressure and/or mounting a pressure switch. The pressure tap points are:

1. Inlet pressure at first SSOV flange tap.
2. Inlet pressure at first SSOV.
3. Outlet pressure at first SSOV.
4. Inlet pressure at second SSOV.
5. Outlet pressure at second SSOV flange tap.

The following pressures can be measured:

1. Inlet pressure—tap on inlet flange (1).
2. Pressure after inlet screen (2).
3. Unregulated intermediate pressure—pressure between the two shutoff seats (P).
4. Regulated intermediate pressure—pressure between the two shutoff valves (3).
5. Outlet pressure—tap from flange (4).

The corresponding numbers (2, P, 3) can be found on the side of the valve.

NOTE: To mount the C6097 Pressure Switch, refer to instructions in form 65-0237, furnished with the switch. The pressure switch can be mounted to 2, P, or 3 on either side of the valve body.

OPERATION

The CS4790A/CS8790A are normally closed valves. The valves open when energized and close when the power is removed.

WARNING

Explosion Hazard and Electrical Shock Hazard. Can cause explosion, serious injury or death.

1. Do not put the system into service until you have satisfactorily completed the Valve Leak Test, all applicable tests described in the Checkout section of the instructions for the flame safeguard control and any other tests required by the burner manufacturer.
2. All test must be performed by a trained, experienced flame safeguard technician.
3. Close all manual fuel shutoff valves immediately if trouble occurs.

After the installation is complete, cycle the valve several times with the manual fuel shutoff cock closed. Make sure the valve functions properly. Also, perform the Valve Leak Test before putting the valve into service.

Valve Leak Test (Fig. 14)

This is a test for checking the closure tightness of the gas shutoff valve. It should be performed only by trained, experienced flame safeguard technicians during the initial startup of the burner system or whenever the valve is replaced. It is recommended that this test also be included in the scheduled inspection and maintenance procedures. For a periodic inspection test, follow steps 1, 3, 4, 5, 8, 9, 10, 12, 13, 16 and 17.

WARNING

Electrical Shock Hazard. Can cause serious injury, death or equipment damage.

Remove the power from the system before beginning the valve leak test. More than one disconnect may be involved.

1. De-energize the control system to make sure no power goes to the valves.
2. Close the upstream manual gas cock (A).
3. Make sure the manual test petcock (F) is closed in the leak test tap assembly
4. To test the first SSOV, remove the 1/8 in. (3 mm) NPT plug from pressure tap point P.
5. Install the leak test tap into pressure tap point P on the valve body.
6. Open the upstream manual gas cock (A) to repressurize the first SSOV.
7. Immerse the 1/4 in. (6 mm) tube vertically 1/2 in. (13 mm) into a jar of water.
8. Slowly open the manual test petcock (F).
9. When the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing during a ten-second period. Each bubble appearing during a 10-second period represents a flow rate of 0.001 cfm (28 cch). See Table 4.
Table 4. Maximum Bubbles per Pipe Size.

<table>
<thead>
<tr>
<th>Pipe Size (in. NPT)</th>
<th>Maximum Seat Leakage (UL)</th>
<th>Maximum Number of Bubbles/10 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2-3/4</td>
<td>235 cch</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>275 cch</td>
<td>7</td>
</tr>
<tr>
<td>1-1/4</td>
<td>340 cch</td>
<td>8</td>
</tr>
</tbody>
</table>

11. Remove the leak test tap from the valve body.
12. Using a small amount of pipe sealant on the 1/8 in. (3 mm) NPT plug, reinstall the plug in pressure tap point P.
13. To test the second SSOV, remove the 1/8 in. (3mm) NPT plug from the flange pressure tap point 4.
14. Install the leak test tap into pressure tap point 4.
15. Close the downstream manual gas cock E.
16. Immerse the 1/4 in. (6 mm) tube vertically 1/2 in. (13 mm) into a jar of water.
17. Slowly open the manual test petcock (F).
18. When the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing during a ten-second period. Each bubble appearing represents a flow rate of 0.001 cfh (28 cch). See Table 2.
19. Remove the leak test tap from the valve body.
20. Using a small amount of pipe sealant on the 1/8 in. (3mm) NPT plug, reinstall the plug in pressure tap point 4.

After the Test
1. Make sure the downstream manual gas cock (E) is closed.
2. Open the upstream manual gas cock (A) and energize the valve through the safety system.
3. Test with rich soap and water solution to make sure there is no leak at the test tap (D) or any pipe adapter/valve mating surfaces.
4. De-energize the valve C.
5. Open the downstream manual gas cock (E).
6. Restore the system to normal operation.

TROUBLESHOOTING

WARNING

Electrical Shock Hazard. Can cause serious injury or death. Use extreme caution while troubleshooting; line voltage is present.

IMPORTANT

Do not replace the valve until all other sources of trouble are eliminated.

Troubleshooting Procedure

If the valve does not open when the thermostat or controller calls for heat:

1. Check for voltage at the valve leadwires or terminal block.
2. If there is no voltage at the valve leadwires or terminal block, make sure:
   a. voltage is connected to the master switch.
   b. master switch is closed and overload protection (circuit breaker, fuse or similar device) has not opened the power line.
3. If there is still no voltage at the valve leadwires or terminal block, make sure all appropriate contacts in the thermostat or controller, limits and flame safeguard controls are closed. If one or more are open, determine the cause(s); correct the trouble and proceed.
4. If there is proper voltage at the valve but the valve still does not open, check for normal gas pressure.
5. If the valve still does not open, replace the valve.

If the valve does not close when one or more of the appropriate contacts in the thermostat, controller, limits or flame safeguard control is open:

1. Make sure the valve is wired in the correct circuit.
2. Open the master switch to remove power from the valve.
3. If the valve closes now, check the wiring for the valve and correct the wiring as necessary.
4. Check for a short in the electrical circuit and repair it as necessary.

SERVICE INFORMATION

WARNING

Explosion Hazard and Electrical Shock Hazard. Can cause explosion, serious injury or death. Turn off gas supply and disconnect all electrical power to the valve before servicing.
IMPORTANT
Only trained, experienced flame safeguard control technicians should attempt to service or repair flame safeguard controls and burner assemblies.

Scheduled Inspection and Maintenance
Set up and follow a schedule for periodic inspection and maintenance, including the burner, all other controls and the valves. It is recommended that the valve leak test in the Checkout section be included in this schedule. Refer to the instructions for the primary safety control(s) for more inspection and maintenance information.

Screen/Strainer Replacement
1. Make sure that the gas supply is turned off and all electrical power has been removed.
2. Remove bolts/nuts from flange/valve.
3. Remove flange from gas supply pipe.
4. Remove old screen/strainer.
5. Clean the strainer by using compressed air or replace the strainer.
6. Install the cleaned strainer or the new strainer.
7. Make sure O-ring sealing surface is clean on flange.
8. Using general purpose lithium grease, grease the O-ring.
9. Apply a moderate amount of good quality pipe dope, resistant to the action of LP gas, only on the pipe threads.
10. Screw the flange onto the pipe.
11. Mount the gas valve to the flange, using the bolts and nuts for each flange.
12. Apply power to the valve.
13. Turn on the main gas supply.
14. Complete the valve leak test.
15. Return the valve to service.