SECTION 4.05
FUEL SYSTEM MAINTENANCE

F18/H24 AND L36/P48 ENGINES

PHYSICAL REQUIREMENTS

Gas supply, pressure, and regulator type will vary with each application. Refer to S6656-23 for applicable regulator information.

1. Regulators and fuel shutoff valves are to be mounted as close to the carburetor as possible (see S-07763-16 for fuel system information).

2. Check/adjust the linkage from the governor to the throttle (butterfly) valve to assure that the butterfly is closed when the governor is in the minimum stroke position. When the governor goes to full stroke, the butterfly must not over travel the wide open, straight up and down position. An angle of 5° toward closing from wide open is acceptable.

3. Ensure that the fuel supply pressure to the regulator inlet is within the acceptable range for the regulator being used. See Tech Data S6656-23.

CAUTION Engines equipped with ejector breather system –O₂ must be sampled pre-turbine.

4. Remove the pipe plug from the exhaust elbow and install the exhaust emission probe and sample line with an on/off valve. Connect this sample line to an exhaust emission analyzer capable of measuring oxygen (O₂) and carbon monoxide (CO) concentrations.

NOTE: L36 and P48 engines with IMPCO carburetors should have pre-turbine sample lines for each bank to assure that the exhaust oxygen of each bank is adjusted properly. For Deltec carburetor systems, use a slant tube or digital manometer to measure the gas/air pressure differential accurately.

5. Install a water manometer and shutoff valves to measure the gas over air (gas/air) pressure differential between the carburetor fuel inlet pipe and the carburetor air horn.

NOTE: The information below is provided as a quick reference guide. Go to the page listed to see the fuel adjustment procedure for specific engine setups.

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F18G AND H24G WITH IMPCO 200 D, 400 VF3 OR 600 VFI CARBURETORS

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

⚠️ WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. Adjust the gas regulator to obtain the proper gas over air (gas/air) pressure (see Table 4.05-1).

Table 4.05-1 Gas Over Air Settings

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>FUEL LOW HEAT VALUE MJ/M³ [25, V(0;101.325)] (BTU/FT³)</th>
<th>GAS/AIR PRESSURE CM H₂O (IN. H₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>33.40–35.38 (850 – 900)</td>
<td>12.7 ± 1.3 (5 ± 0.5)</td>
</tr>
<tr>
<td>Digester Gas</td>
<td>19.65 – 25.55 (500 – 650)</td>
<td>15.2 ± 1.3 (6 ± 0.5)</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>15.73 – 19.65 (400 – 500)</td>
<td>25.4 ± 1.3 (10 ± 0.5)</td>
</tr>
</tbody>
</table>

2. F18G/H24G Engines (IMPCO 200 D)
   A. Adjust the carburetor idle air bleed screw full in (rich). This bleed screw will remain in this position and not be used again.
   B. Adjust the fuel mixture valve at the fuel inlet to the mid-position between L and R.

3. F18G/H24G Engines (400 VF3 and IMPCO 600 VFI)
   A. Adjust the mixture screw approximately 4 to 5 turns out counterclockwise (CCW) from the full-in clockwise (CW) position.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

1. At idle speed (700 + 50 rpm) and no load, adjust the gas regulator to obtain the gas/air pressure listed in Table 4.05-1.
2. Follow break-in procedure if not previously broken-in.

FINAL FUEL SYSTEM ADJUSTMENTS

⚠️ CAUTION

Always verify that all cylinders are firing before adjusting the carburetor. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O₂ levels may also indicate misfires. Failure to do so may cause serious engine damage.

NOTE: If the correct O₂ level cannot be obtained at rated speed and load, readjust the gas/air pressure as necessary.

- On 200 D carburetors rotate the mixture valve toward “L” (Lean) to increase the exhaust O₂ level and toward “R” (Rich) to decrease the O₂ level.
- On 400 VF3 and 600 VFI carburetors, turn the mixture screw in CW to increase O₂ and out CCW to decrease exhaust O₂.

Impco 200 D carburetors only: If the fuel mixture adjustment is very coarse or if the correct O₂ level cannot be obtained at rated speed and load, check to see that the proper fuel orifice has been installed in the carburetor fuel inlet (see Table 4.05-2). If the proper orifice is present, readjust gas/air pressure as necessary to obtain the desired O₂ level.

Table 4.05-2 Impco 200 D Fuel Orifice Requirements

<table>
<thead>
<tr>
<th>FUEL ORIFICE ID</th>
<th>F18GL</th>
<th>H24GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in.)</td>
<td>0.591</td>
<td>0.650</td>
</tr>
<tr>
<td>(mm)</td>
<td>15</td>
<td>16.5</td>
</tr>
</tbody>
</table>

1. At rated load and speed, adjust the carburetor mixture as follows:

A. For Best Power:
   1) Adjust the carburetor mixture to obtain approximately 0.18% exhaust O₂ and 0.3 to 1.0% carbon monoxide (CO).
      or
   2) Adjust the carburetor mixture to obtain the maximum intake manifold vacuum setting or to obtain the highest exhaust temperature.

B. For Best Economy:
   1) Adjust the carburetor mixture to obtain 2.4% exhaust O₂ and 0.02% CO.
      or
   2) Adjust the carburetor mixture to obtain the maximum intake manifold vacuum setting (i.e. highest exhaust temperature) and then lean out mixture to decrease vacuum by 1.5 in. of mercury (Hg).
Figure 4.05-1 Typical High Pressure Fuel System (In-line Engine Shown)

F18GL/H24GL AND L36GL/P48GL WITH IMPCO 200 D OR 600 VFI CARBURETORS NATURAL GAS (BLOW-THRU CARBURETION)

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

1. Adjust the gas regulator to obtain the proper gas over air (gas/air) pressure (see Table 4.05-3). For typical pressure tap locations see Figure 4.05-1.

2. F18GL/H24GL Engines (IMPCO 200 D)
   A. Adjust the carburetor idle air bleed full in (rich). This bleed screw will remain in this position and not be used again.
   B. Adjust the fuel mixture valve at the fuel inlet to the mid-position between L and R.
   C. Turn the butterfly valve adjusting screw 1-1/2 turns open.

3. L36GL/P48GL Engines (IMPCO 600 VFI)
   A. Adjust the mixture screw to approximately 4 to 5 turns out counterclockwise (CCW) from the full-in clockwise (CW) position.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

Table 4.05-3 Gas/Air And Exhaust Oxygen Settings

<table>
<thead>
<tr>
<th>MODEL</th>
<th>IMPCO CARB.</th>
<th>GAS/AIR PRESSURE CM H₂O (IN. H₂O)</th>
<th>EXHAUST OXYGEN (% O₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F18GL/H24GL</td>
<td>200 D</td>
<td>7.6 ± 2.54 (3 ± 1.0)</td>
<td>7.8 ± 0.1</td>
</tr>
<tr>
<td>L36GL/P48GL</td>
<td>600 VFI</td>
<td>15.2 ± 1.27 (6 ± 0.5)</td>
<td>7.8 ± 0.1</td>
</tr>
</tbody>
</table>

WARNING
Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. At idle speed (700 ± 50 rpm) and no load, adjust the gas regulator to obtain the proper gas/air pressure (see Table 4.05-3).

2. Follow break-in procedure (if not previously broken-in) up to rated speed and 2/3 of rated load (approximately 23.7 – 30.5 kPa (7 – 9 in.) of mercury (Hg) gauge positive intake manifold pressure). Adjust the fuel mixture valve to obtain 7.8 ± 0.5% exhaust oxygen (O₂).
FUEL SYSTEM MAINTENANCE

FINAL FUEL SYSTEM ADJUSTMENTS

Always verify that all cylinders are firing before adjusting the carburetor. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O\textsubscript{2} levels may also indicate misfires. Failure to do so may cause serious engine damage.

1. At rated speed and load, check the gas/air pressure and ready to specified value (see Table 4.05-3), if necessary.

Table 4.05-4 Impco 200 D Fuel Orifice Requirements

<table>
<thead>
<tr>
<th>FUEL ORIFICE ID</th>
<th>F18GL</th>
<th>H24GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in.)</td>
<td>0.591</td>
<td>0.650</td>
</tr>
<tr>
<td>(mm)</td>
<td>15</td>
<td>16.5</td>
</tr>
</tbody>
</table>

2. F18GL/H24GL Engines

A. On 200 D carburetors rotate the mixture valve toward “L” (Lean) to increase the exhaust O\textsubscript{2} level, toward “R” (Rich) to decrease the O\textsubscript{2} level.

B. If the fuel mixture adjustment is very coarse or if the correct O\textsubscript{2} level cannot be obtained at rated speed and load, check to see that the proper fuel orifice has been installed in the carburetor fuel inlet (see Table 4.05-4). If the proper orifice is present, readjust gas/air pressure as necessary to obtain the desired O\textsubscript{2} level.

3. L36GL/P48GL Engines

**NOTE:** On L36/P48 GLD and GSID engines the left bank carburetor will affect the right bank O\textsubscript{2} level, and the right bank carburetor will affect the left bank O\textsubscript{2} level.

**NOTE:** After testing at standard exhaust oxygen, reset the exhaust O\textsubscript{2} to the setting indicated on the engine nameplate.

A. On 600 VFI carburetors, rotate the fuel mixture valves CW (lean) to increase exhaust %O\textsubscript{2} level and CCW (rich) to decrease exhaust %O\textsubscript{2} level.

F18GL/H24GL WITH IMPCO 400 VF3 CARBURETORS — NATURAL GAS OR LOW COMPRESSION RATIO (NATURAL GAS OR PROPANE) (BLOW-THRU CARBURETION)

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

1. Adjust the gas regulator to obtain the proper gas over air (gas/air) pressure (see Table 4.05-5).

2. Adjust the fuel mixture to approximately two to three turns out counterclockwise (CCW) from the full-in clockwise (CW) position.

Table 4.05-5 F18GL/H24GL Gas/Air Settings

<table>
<thead>
<tr>
<th>COMPRESSION IMPCO CARB.</th>
<th>GAS/AIR CM H\textsubscript{2}O (IN. H\textsubscript{2}O)</th>
<th>EXHAUST OXYGEN (%O\textsubscript{2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (8.7:1) Pistons 400 VF3</td>
<td>7.6 ± 2.54 (3 ± 1.0)</td>
<td>7.8 ± 0.1</td>
</tr>
<tr>
<td>Standard (11:1) Pistons 400 VF3</td>
<td>12.7 ± 2.54 (5 ± 1.0)</td>
<td>7.8 ± 0.1</td>
</tr>
</tbody>
</table>

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

1. At idle speed (700 ± 50 rpm) and no load, adjust the gas regulator to obtain the proper gas/air pressure (see Table 4.05-5).

2. Follow the break-in procedure if not previously broken-in up to rated speed and 2/3 load (approximately 23.7 – 30.5 kPa (7 - 9 in.) of mercury (Hg) gauge positive intake manifold pressure). Adjust the fuel mixture screw to obtain 7.8 ± 0.5 % exhaust oxygen (O\textsubscript{2}).

FINAL FUEL SYSTEM ADJUSTMENTS

Always verify that all cylinders are firing before adjusting the carburetor. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O\textsubscript{2} levels may also indicate misfires. Failure to do so may cause serious engine damage.

1. At rated speed and load, check the gas/air pressure and, if necessary, readjust to obtain the proper pressure (see Table 4.05-5).

A. Rotate the fuel mixture screw CW (lean) to increase exhaust %O\textsubscript{2} level and CCW (rich) to decrease exhaust %O\textsubscript{2} level.

**NOTE:** After testing at standard exhaust O\textsubscript{2}, reset the exhaust O\textsubscript{2} to the setting indicated on the engine nameplate.
F18GLD/H24GLD AND L36GLD/P48GLD WITH IMPCO 600 VFI CARBURETORS (DRAW-THRU CARBURETION)

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

1. Adjust the gas regulator(s) to obtain a gas over air (gas/air) pressure listed in Table 4.05-6.

2. F18GLD/H24GLD Engines
   A. Adjust the fuel mixture screw to approximately 4 to 5 turns out counterclockwise (CCW) from the full-in clockwise (CW) position (see Figure 4.05-2). The coarse upstream mixture valve, if equipped, can be left in the full open position at this time.

3. L36GLD/P48GLD Engines
   A. Adjust the fuel mixture screw to approximately 4 turns out CCW from the full-in CW position. Set both upstream mixture valves, if equipped, to approximately 30° from full closed.

Table 4.05-6 Gas/Air Settings

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>FUEL LOW HEAT VALUE (BTU/FT³)</th>
<th>GAS/AIR PRESSURE CM H₂O (IN. H₂O)</th>
<th>EXHAUST OXYGEN (% O₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>850 – 900</td>
<td>7.6 ± 1.27 (3 ± 0.5)</td>
<td>7.8 ± 0.1</td>
</tr>
<tr>
<td>Digester Gas</td>
<td>500 – 650</td>
<td>See Figure 4.05-3</td>
<td>See Figure 4.05-4</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>400 – 500</td>
<td>See Figure 4.05-3</td>
<td>See Figure 4.05-4</td>
</tr>
</tbody>
</table>

WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. At idle speed (700 ± 50 rpm) and no load, adjust the gas regulator(s) to obtain a gas/air pressure listed in Table 4.05-6.
2. Follow break-in procedure if not previously broken-in up to rated speed and 2/3 load (approximately 23.7 – 30.5 kPa (7 – 9 in.) of mercury (Hg) gauge intake manifold pressure).

   A. Adjust the coarse upstream mixture valve, if equipped, to obtain the required exhaust O\textsubscript{2} level listed in Table 4.05-6 to within ± 0.5% O\textsubscript{2}. If not equipped with a coarse mixture valve, use the carburetor mixture screw to adjust the exhaust O\textsubscript{2}.

3. L36GLD/P48GLD Engines

   A. Adjust both upstream mixture valves, if equipped, to obtain the required exhaust O\textsubscript{2} level listed in Table 4.05-6 to within ± 0.5% O\textsubscript{2}.

**NOTE:** To change the exhaust O\textsubscript{2} of the left bank, adjust the mixture valve on the right side of the engine. To change the exhaust O\textsubscript{2} of the right bank, adjust the mixture valve on the left side of the engine.

**FINAL FUEL SYSTEM ADJUSTMENTS**

**CAUTION** Always verify that all cylinders are firing before adjusting the carburetor. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O\textsubscript{2} levels may also indicate misfires. Failure to do so may cause serious engine damage.

1. F18GLD/H24GLD Engines

   A. At rated speed and load, check the gas/air pressure and readjust, if necessary, to the appropriate setting listed in Table 4.05-7. Adjust the carburetor mixture screw to obtain an appropriate exhaust, O\textsubscript{2} level as listed in Table 4.05-7 to within ± 0.1% O\textsubscript{2}.

2. L36GLD/P48GLD Engines

   A. At rated speed and load, check the gas/air pressure and readjust, if necessary, to the appropriate setting listed in Table 4.05-7. Adjust the carburetor mixture screw to obtain an appropriate exhaust O\textsubscript{2} level as listed in Table 4.05-7 to within ± 0.1% O\textsubscript{2}.

---

**Table 4.05-7 Gas/Air Settings**

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>FUEL LOW HEAT VALUE (BTU/FT\textsuperscript{3})</th>
<th>GAS/AIR PRESSURE CM H\textsubscript{2}O (IN. H\textsubscript{2}O)</th>
<th>EXHAUST OXYGEN (% O\textsubscript{2})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>850 – 900</td>
<td>7.6 ± 1.27 (3 ± 0.5)</td>
<td>7.8 ± 0.1</td>
</tr>
<tr>
<td>Digester Gas</td>
<td>500 – 650</td>
<td>See Figure 4.05-3</td>
<td>See Figure 4.05-4</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>400 – 500</td>
<td>See Figure 4.05-3</td>
<td>See Figure 4.05-4</td>
</tr>
</tbody>
</table>

**Figure 4.05-4 Exhaust Oxygen vs. Fuel LHV**

**NOTE:** To change the exhaust O\textsubscript{2} of the left bank, adjust the mixture valve on the right side of the engine. To change the exhaust O\textsubscript{2} of the right bank, adjust the mixture valve on the left side of the engine.

**NOTE:** After testing at standard exhaust O\textsubscript{2}, reset the exhaust O\textsubscript{2} to the setting indicated on the engine nameplate.
F18GLD/H24GLD AND L36GLD/P48GLD WITH DELTEC CARBURETORS (DRAW-THRU CARBURETION)

PHYSICAL REQUIREMENTS

- See "Physical Requirements" on page 4.05-1 for all VGF F18/H24 and L36/P48 Models.
- Regulators are to be mounted less than 0.91 m (3 ft) before the Main Adjustment Screw (MAS) with no elbows or other plumbing restrictions.
- Fuel shutoff valves must be mounted prior to the engine gas regulator.

WARNING

The Deltec carburation system must have a positive gas shutoff valve that opens upon cranking and closes whenever engine rotation stops. Failure to provide the valve will cause an explosive environment resulting in severe personal injury or death.

- A quick acting, manual shutoff valve, placed up stream of the engine regulator (high pressure gas line), is recommended. This valve will assist initial engine startup and will act as a visual gas shutoff when the engine is not in operation.
FUEL SYSTEM MAINTENANCE

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

⚠️ WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

⚠️ WARNING

When the manual gas shutoff valve is open, gas flows both into the exhaust and back through the intake and air cleaners. Adjustments should be made quickly to avoid severe personal injury or death.

1. Open manual gas shutoff valve.
2. Adjust the gas regulator to obtain gas over air (gas/air) pressure listed in Table 4.05-8.
3. Adjust the MAS approximately eight turns out from full closed.
5. Crank engine with ignition off for ten seconds to purge the engine of gas fumes.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

1. Open manual gas shutoff valve and start the engine.
2. Follow break-in procedure up to rated speed and 2/3 load (approximately 23.7 – 30.5 kPa (7 – 9 in.) of mercury (Hg) gauge positive intake manifold pressure), if not previously broken in. Adjust the exhaust oxygen (O₂) to 7.0 ± 0.5% using only the MAS.
3. Once engine coolant and oil temperatures have sufficiently warmed up 60 – 71°C (140 – 160°F), increase engine to rated speed.

Table 4.05-8 Gas/Air And Exhaust Oxygen Settings

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>FUEL LOW HEAT VALUE (BTU/FT³)</th>
<th>IDLE GAS AIR PRESSURE CM H₂O (IN. H₂O)</th>
<th>EXHAUST OXYGEN (%O₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>850 – 900</td>
<td>0.5 ± 0.25 (0.2 ± 0.1)</td>
<td>7.8 ± 0.1</td>
</tr>
<tr>
<td>Digester Gas</td>
<td>500 – 650</td>
<td>See Figure 4.05-6</td>
<td>See Figure 4.05-7</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>400 – 500</td>
<td>19.5 ± 6.4 (7.62 ± 2.54)</td>
<td>7.5 ± 0.1</td>
</tr>
<tr>
<td>Propane Gas</td>
<td>2200 – 2500</td>
<td>9.6 ± 6.4 (3.81 ± 2.54)</td>
<td>8.2 ± 0.1</td>
</tr>
</tbody>
</table>

CAUTION: Always verify that all cylinders are firing before adjusting the carburetor or mixture valves. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O₂ levels may also indicate misfires. Failure to do so may cause serious engine damage.

1. At rated speed and no load, adjust the gas/air to the pressure listed in Table 4.05-8, using only the MAS.

NOTE: Adjust gas/air pressure within the tolerance band to optimize starting for all fuels.

2. Reduce speed and load to idle, and check gas/air pressure. If gas/air is out of specification (see Table 4.05-8), readjust the gas regulator as necessary.

4.05-8 FORM 6284 Third Edition
3. Increase the load to 100% and check exhaust O\textsubscript{2} (see Table 4.05-8). If exhaust O\textsubscript{2} is out of specification, readjust MAS as necessary.

4. Stop engine and check starting performance.

**L36GSID/P48GSID WITH DELTEC CARBURETORS – NATURAL GAS OR PROPANE (DRAW-THRU CARBURETION)**

**PHYSICAL REQUIREMENTS**

- See page 4.05-1 for "Physical Requirements" on all VGF F18/H24 and L36/P48 Models.
- Regulators are to be mounted less than 0.91 m (3 ft.) before the Main Adjustment Screw (MAS) with no elbows or other plumbing restrictions.
- Fuel shutoff valves must be mounted prior to the engine gas regulator.

**WARNING**

The Deltec carburetion system must have a positive gas shutoff valve that opens upon cranking and closes whenever engine rotation stops. Failure to provide the valve will cause an explosive environment resulting in severe personal injury or death.

- A quick acting, manual shutoff valve, placed up stream of the engine regulator (high pressure gas line), is recommended. This valve will assist initial engine startup and will act as a visual gas shutoff when engine is not in operation.

**FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP**

**WARNING**

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

**WARNING**

When the manual gas shutoff valve is open, gas flows both into the exhaust and back through the intake and air cleaners. Adjustments should be made quickly to avoid severe personal injury or death.

1. Open manual gas shutoff valve.
2. Adjust the gas regulator to obtain a gas over air (gas/air) pressure of 0 – 2.54 mm (0 – 0.1 in.) of water column (H\textsubscript{2}O).
3. Adjust the MAS approximately eight turns out from full closed.
5. Crank engine with ignition off for ten seconds to purge engine of gas fumes.

**FINAL FUEL SYSTEM ADJUSTMENTS**

- Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O\textsubscript{2} levels may also indicate misfires. Failure to do so may cause serious engine damage.

1. At rated speed and load, adjust the MAS valve to obtain an exhaust stack carbon monoxide (CO) level of 0.3 – 0.4%. Turn the MAS clockwise (CW) to reduce CO, or counterclockwise (CCW) to increase CO.

**NOTE:** Exhaust tap location should be such that is simultaneously sampling exhaust from both the left and right banks.

2. Reduce the engine speed and load to idle. Verify that the gas/air pressure is still within 0 – 2.54 mm (0 – 0.1 in.) of H\textsubscript{2}O. Readjust the gas regulator if necessary.

3. Increase the speed and load to 100%. Verify that the exhaust stack CO level is still within 0.3 – 0.4%. Readjust the MAS if necessary.

4. Stop the engine and recheck starting performance.

**NOTE:** Adjust the gas/air pressure within the tolerance band to optimize starting for all fuels.

**F18/H24GSID WITH IMPCO 600 VFI CARBURETOR – NATURAL GAS (DRAW-THRU CARBURETION)**

**FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP**

1. Adjust the gas regulator to obtain a gas/air pressure of 6.35 ± 1.27 cm (2.5 ± 0.5 in.) of water column (H\textsubscript{2}O).
2. Adjust the fuel mixture screw six turns out counterclockwise (CCW) from the full-in clockwise (CW) position.
PRELIMINARY SETTINGS AFTER ENGINE STARTUP

⚠️ WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

At idle speed (700 ± 50 rpm) and no load, adjust the gas regulator to obtain a gas/air pressure of 6.35 ± 1.27 cm (2.5 ± 0.5 in.) of H₂O.

FINAL FUEL SYSTEM ADJUSTMENTS

At rated load and speed, adjust the carburetor mixture screw to obtain 0.18% exhaust oxygen (O₂) and 0.3 to 0.4% carbon monoxide (CO).

F18G/H24G DUAL FUEL – NATURAL GAS OR PROPANE

NOTE: Refer to Figure 4.05-8 for the VGF Dual Fuel System Diagram.

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

1. Set the line regulator to provide the proper fuel gas inlet pressures to the engine mounted regulators in accordance with the settings below (see Table 4.05-9).

2. If equipped with an IMPCO 200D carburetor:
   A. Adjust the carburetor idle bleed valve full in (rich).
   B. Adjust the carburetor mixture valve to mid position.

3. If equipped with an IMPCO 600 VFI carburetor:
   A. Adjust the carburetor mixture screw 4 to 5 turns out counterclockwise (CCW) from the full-in clockwise (CW) position.

4. Close the propane solenoid valve and open the natural gas solenoid valve.

Table 4.05-9 Fuel Regulator Pressure Settings

<table>
<thead>
<tr>
<th>REGULATOR TYPE</th>
<th>FUEL TYPE</th>
<th>INLET PRESSURE</th>
<th>OUTLET PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisher S201</td>
<td>Natural Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>12.7 ± 1.27 cm (5 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Maxitrol RV91</td>
<td>Natural Gas</td>
<td>2.0 – 5.0 kPa (8 – 20 in. H₂O)</td>
<td>7.6 ± 1.27 cm (3 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Fisher Y610-A w/ Fisher S201</td>
<td>Propane Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>-2.54 – -5.1 cm (-1 – -2 in.) H₂O</td>
</tr>
<tr>
<td>Fisher Y610-A w/Maxitrol RV91</td>
<td>Propane Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>10.2 ± 1.27 cm (4 ± 0.5 in.) H₂O</td>
</tr>
</tbody>
</table>

2. If equipped with an IMPCO 200D carburetor:
   A. Adjust the carburetor idle bleed valve full in (rich).
   B. Adjust the carburetor mixture valve to mid position.

3. If equipped with an IMPCO 600 VFI carburetor:
   A. Adjust the carburetor mixture screw 4 to 5 turns out counterclockwise (CCW) from the full-in clockwise (CW) position.

4. Close the propane solenoid valve and open the natural gas solenoid valve.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

⚠️ WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. Idle the engine at 700 ± 50 rpm and adjust the natural gas regulator for an outlet pressure of 12.7 ± 1.27 cm (5 ± 0.5 in.) of water column (H₂O) gas over air (gas/air).

NOTE: The intake manifold vacuum reading can be taken at the instrument panel gauge, if equipped. If not equipped, remove the plug at the top rear of the intake manifold and install a gauge.

2. At governed speed and rated load, adjust the carburetor mixture valve as follows:
   A. For Best Power do one of the following:
      1) Adjust the carburetor mixture valve to approximately 0.18% oxygen (O₂) and 0.3 – 1.0% carbon monoxide (CO).
      or
      2) Adjust the carburetor mixture valve to obtain the maximum intake manifold vacuum setting.
   B. For Best Economy do one of the following:
      1) Adjust the carburetor mixture valve to approximately 2.4% O₂ and 0.02% CO.
      or
      2) Adjust the carburetor mixture valve to the maximum intake manifold vacuum setting and then lean out by 3.8 cm (1.5 in.) of mercury (Hg).

3. Return to idle.

4. Close the natural gas solenoid valve and open the propane solenoid valve.

5. Adjust the propane regulator outlet pressure to 3.8 ± 1.2 cm (1.5 ± 0.5 in.) of H₂O gas/air.

6. At governed speed and rated load, adjust the mixture adjusting valve for Best Economy or Best Power in accordance with Step 2.

WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

Table 4.05-9 Fuel Regulator Pressure Settings

<table>
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<tr>
<td>Fisher S201</td>
<td>Natural Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>12.7 ± 1.27 cm (5 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Maxitrol RV91</td>
<td>Natural Gas</td>
<td>2.0 – 5.0 kPa (8 – 20 in. H₂O)</td>
<td>7.6 ± 1.27 cm (3 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Fisher Y610-A w/ Fisher S201</td>
<td>Propane Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>-2.54 – -5.1 cm (-1 – -2 in.) H₂O</td>
</tr>
<tr>
<td>Fisher Y610-A w/Maxitrol RV91</td>
<td>Propane Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>10.2 ± 1.27 cm (4 ± 0.5 in.) H₂O</td>
</tr>
</tbody>
</table>

WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. Idle the engine at 700 ± 50 rpm and adjust the natural gas regulator for an outlet pressure of 12.7 ± 1.27 cm (5 ± 0.5 in.) of water column (H₂O) gas over air (gas/air).

NOTE: The intake manifold vacuum reading can be taken at the instrument panel gauge, if equipped. If not equipped, remove the plug at the top rear of the intake manifold and install a gauge.

2. At governed speed and rated load, adjust the carburetor mixture valve as follows:
   A. For Best Power do one of the following:
      1) Adjust the carburetor mixture valve to approximately 0.18% oxygen (O₂) and 0.3 – 1.0% carbon monoxide (CO).
      or
      2) Adjust the carburetor mixture valve to obtain the maximum intake manifold vacuum setting.
   B. For Best Economy do one of the following:
      1) Adjust the carburetor mixture valve to approximately 2.4% O₂ and 0.02% CO.
      or
      2) Adjust the carburetor mixture valve to the maximum intake manifold vacuum setting and then lean out by 3.8 cm (1.5 in.) of mercury (Hg).

3. Return to idle.

4. Close the natural gas solenoid valve and open the propane solenoid valve.

5. Adjust the propane regulator outlet pressure to 3.8 ± 1.2 cm (1.5 ± 0.5 in.) of H₂O gas/air.

6. At governed speed and rated load, adjust the mixture adjusting valve for Best Economy or Best Power in accordance with Step 2.
F18G/H24G DUAL FUEL – NATURAL GAS OR DIGESTER GAS

NOTE: Refer to Figure 4.05-8 for the VGF Dual Fuel System Diagram.

FUEL SYSTEM ADJUSTMENT PRIOR TO ENGINE STARTUP

1. Set the line regulator to provide the proper fuel gas inlet pressures to the engine mounted regulators in accordance with the settings below (see Table 4.05-10).

2. Adjust carburetor mixture valve to mid-position (4 or 5 turns out).

3. Shut the natural gas solenoid valve and open the digester gas solenoid valve.

PRELIMINARY SETTINGS AFTER ENGINE STARTUP

WARNING

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

1. Idle the engine at 700 ± 50 rpm and adjust the digester gas regulator to the outlet pressure shown in Table 4.05-10.

Table 4.05-10 Fuel Regulator Pressure Settings

<table>
<thead>
<tr>
<th>REGULATOR TYPE</th>
<th>FUEL TYPE</th>
<th>INLET PRESSURE</th>
<th>OUTLET PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisher Y610-A P/N 209678-S</td>
<td>Natural Gas</td>
<td>34.5 – 69.0 kPa (5 – 10 psi)</td>
<td>-12.7 ± -15.3 cm (-5 – -6 in.) H₂O</td>
</tr>
<tr>
<td>Maxitrol RV91</td>
<td>Digester Gas</td>
<td>20 – 50.8 cm (8 – 20 in.) H₂O</td>
<td>15.3 ± 1.27 cm (6 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Fisher Y610-A P/N 209678-C</td>
<td>Natural Gas</td>
<td>34.5 – 69.0 kPa (0.75 – 10 psi)</td>
<td>-5.1 ± 1.27 cm (-2 ± 0.5 in.) H₂O</td>
</tr>
<tr>
<td>Maxitrol RV91</td>
<td>Digester Gas</td>
<td>2.0 – 5.0 kPa (8 – 20 in. H₂O)</td>
<td>12.7 ± 1.27 cm (5 ± 0.5 in.) H₂O</td>
</tr>
</tbody>
</table>
2. At governed speed and rated load, adjust the carburetor mixture valve as follows:

**NOTE:** The intake manifold vacuum reading can be taken at the instrument panel gauge, if equipped. If not equipped, remove the plug at the top rear of the intake manifold and install a gauge.

A. For Best Power do one of the following:
   1) Adjust the carburetor mixture valve to approximately 0.18% oxygen (O\(_2\)) and 0.3 – 1.0% carbon monoxide (CO).

   or

2) Adjust the carburetor mixture valve to the maximum intake manifold vacuum setting.

B. For Best Economy do one of the following:
   1) Adjust the carburetor mixture valve to approximately 2.4% O\(_2\) and 0.02% CO.

   or

2) Adjust the carburetor mixture valve to the maximum intake manifold vacuum setting and then lean out by 3.8 cm (1.5 in.) of mercury (Hg).

3. Return to idle.

4. Close the digester gas solenoid valve and open the natural gas solenoid valve.

5. Adjust the natural gas regulator as indicated in Table 4.05-10.

6. Return to idle.

7. Close the digester gas solenoid valve and open the natural gas solenoid valve.

8. Adjust natural gas regulator according to Table 4.05-10.

9. At the governed speed and rated load, adjust the mixture adjusting valve for best economy or best power in accordance with Step 2.

**F18/H24GLD AND L36/P48GLD/GSID WITH DELTEC CARBURETORS – DUAL FUEL**

**PHYSICAL REQUIREMENTS**

- See "Physical Requirements" on page 4.05-1 for all VGF F18/H24 and L36/P48 Models.
- Regulators are to be mounted less than 0.91 m (3 ft.) before the Main Adjustment Screw (MAS) with no elbows or other plumbing restrictions.
- Fuel shutoff valves must be mounted prior to the engine gas regulator.

---

**WARNING**

The Deltec carburetion system must have a positive gas shutoff valve that opens upon cranking and closes whenever engine rotation stops. Failure to provide the valve will cause an explosive environment resulting in severe personal injury or death.

- A quick acting, manual shutoff valve, placed up stream of the engine regulator (high pressure gas line), is recommended. This valve will assist initial engine startup and will act as a visual gas shutoff when engine is not in operation.

**FUEL SYSTEM ADJUSTMENT PROCEDURE**

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**WARNING**

Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

---

**WARNING**

When the manual gas shutoff valve is open, gas flows both into the exhaust and back through the intake and air cleaners. Adjustments should be made quickly to avoid severe personal injury or death.

1. Shut off the downstream fuel valve, and open the upstream fuel valve.

**NOTE:** The higher Btu fuel is always downstream of the lower Btu fuel (see Figure 4.05-9).

2. Adjust the gas regulator to obtain a gas over air (gas/air) pressure of 0 – 2.54 mm (0 – 0.1 in.) of water column (H\(_2\)O).

3. Adjust the MAS approximately eight turns out from full closed.


5. Crank engine with ignition off for ten seconds to purge engine of gas fumes.

---

**CAUTION**

Always verify that all cylinders are firing before adjusting the carburetor or mixture valves. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O\(_2\) levels may also indicate misfires. Failure to do so may cause serious engine damage.
6. At rated speed and load, adjust the MAS valve to obtain an exhaust stack carbon monoxide (CO) level of 0.3 – 0.4%. Turn the MAS clockwise (CW) to reduce CO, or counterclockwise (CCW) to increase CO.

**NOTE:** The exhaust tap location should be such that it is simultaneously sampling exhaust from both the left and right banks.

**NOTE:** Adjust the gas/air pressure within the tolerance band to optimize starting for all fuels.

7. Reduce the engine speed and load to idle. Verify that the gas/air pressure is still within 0 – 2.54 mm (0 – 0.1 in.) of H₂O. Readjust the gas regulator if necessary.

8. Increase the speed and load to 100%. Verify that the exhaust stack CO level is still within 0.3 – 0.4%. Readjust the MAS if necessary.

9. Stop the engine.

10. Shut off the upstream fuel valve, and open the downstream fuel valve.

11. Repeat Steps 2 – 9 and adjust the downstream fuel settings.


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**Figure 4.05-9 L36/P48 VGF Dual Fuel System With Deltec Carburetor**

**HIGH RATING (HR) 12.1/13.7 BAR (176/200 BMEP) GLD/2 WITH DELTEC CARBURETORS AND DUNGS® REGULATOR**

**PHYSICAL REQUIREMENTS**

- See "Physical Requirements" on page 4.05-1 for all VGF F18/H24 and L36/P48 Models.

- Regulators are to be mounted less than 0.91 m (3 ft.) before the Main Adjustment Screw (MAS) with no elbows or other plumbing restrictions.

- Fuel shutoff valves must be mounted prior to the engine gas regulator.

---

**WARNING**

The Deltec carburetion system must have a positive gas shutoff valve that opens upon cranking and closes whenever engine rotation stops. Failure to provide the valve will cause an explosive environment resulting in severe personal injury or death.

- A quick acting, manual shutoff valve, placed upstream of the engine regulator (high pressure gas line), is recommended. This valve will assist initial engine startup and will act as a visual gas shutoff when engine is not in operation.
FUEL SYSTEM ADJUSTMENT PROCEDURE

**WARNING**
Do not inhale gaseous fuels. Some components of fuel gas are odorless, tasteless, and highly toxic. Inhalation of gaseous fuels can cause severe personal injury or death.

**CAUTION** Always verify that all cylinders are firing before adjusting the carburetor or mixture valves. Exhaust manifold thermocouples (optional equipment) will assist in diagnosing misfiring cylinders. Unstable or high exhaust O₂ levels may also indicate misfires. Failure to do so may cause serious engine damage.

The “start circuit” consists of fuel at supply pressure provided to a fuel solenoid. This solenoid is activated/opened when the starter is engaged. The fuel at that time flows from the solenoid to a needle valve which is set to deliver 7 mm (0.276 in.) H₂O pressure. This pressure is applied on top of the diaphragm which lowers/closes the valve and leans out the mixture to about 0 mm (0 in.) H₂O G/A. When the starter disengages the fuel flow stops and the regulator goes back to delivering about 7 mm (0.276 in.) H₂O G/A for throttle advancement.

The “cold run circuit” was developed because the standard G/A proved to be too lean when the intake manifold temperature is less than 60° C (140° F). This is a normal condition when the engine is first started. It takes a little time for the intake manifold to come up to normal temperatures. To increase the G/A mixture an additional circuit has been added. Fuel at supply pressure is provided to a fuel solenoid. This solenoid is activated/opened when the thermistor/sending unit in the intake manifold detects mixture that is less than 60° C (140° F). The fuel at that time flows from the solenoid to a needle valve which is set to deliver about 8 mm (0.32 in.) H₂O G/A to the Deltec carburetor. When the thermistor/sending unit detects mixture at 60° C (140° F) or more the solenoid is closed and the G/A defaults back to the main regulator setting.

**NOTE:** A gas over air (G/A) pressure of 0 mm (0 in.) of water column (H₂O) is correct for initial start (crank mode), but proves to be too lean when advancing the throttle. A gas/air pressure of 7 mm (0.276 in.) H₂O is required for throttle advancement, however this is too rich for initial start. To solve this problem the following procedure has been developed.

2. Crank engine with ignition off for ten seconds to purge engine of gas fumes.
3. Remove four hex head screws that secure cover to Dungs regulator (see Figure 4.05-10). Remove cover to expose valve.

![Figure 4.05-10 Dungs Regulator](image)

4. Turn adjustment screw so valve travels down and “just touches” seat. Verify valve position through top cover opening (see Figure 4.05-10). When valve is closed, gas over air (G/A) pressure is 0 mm (0 in.) of water column (H₂O).
5. Install regulator cover and secure with four hex head screws.

**WARNING**
When the manual gas shutoff valve is open, gas flows both into the exhaust and back through the intake and air cleaners. Adjustments should be made quickly to avoid severe personal injury or death.

**NOTE:** A “hot wire” that can provide momentary power to the fuel solenoid must be installed. The power lead from the starter must be disconnected at the fuel solenoid after the engine is started. This will prevent the voltage from back feeding to the starter.

6. Start engine and adjust G/A to 7 mm (0.276 in.) H₂O and advance throttle to 1500 rpm.
7. Disconnect power lead from fuel solenoid to starter (this prevents the starter from running when power is applied to the fuel solenoid).
8. Apply power (bypass starter) to the fuel solenoid valve (this will allow fuel to flow through to the needle valve). Adjust the needle valve until a G/A pressure of 0 mm (0 in.) H₂O is reached.