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GFI **Service Manual** Natural Gas Systems



The Gaseous Fuel Injection (GFI) system by GFI Control System, Inc. is certified under I-85 of the American Gas Association (AGA). This certification is based on the prescribed installation instructions and those components listed in the approved parts manual. The information contained in or disclosed in this document is considered proprietary to GFI Control Systems, Inc. Reproduction by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system or translation in whole or part is not permitted without written authorization from GFI Control Systems, Inc.

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TERMS AND ABBREVIATIONS

The following is a list of terms and abbreviations that may appear in description and drawing nomenclature.

A/R.....As Required	IPC..... Illustrated Parts Catalog
AFVAlternative Fueled Vehicle	KOEO..... Key On, Engine Off
ALT.....Alternate	KOER..... Key On, Engine Running
ARCAccessory Reserve Capacity	LH..... Left Hand (driver's side)
ASSYAssembly	MAP Manifold Absolute Pressure
AWG.....Average Wire Gauge	MIL..... Malfunction Indicator Light
B+Direct Battery Power	mm..... Millimeter
BAP.....Barometric Absolute Pressure	MST..... Manifold Skin Temperature
BATTBattery Power	NG Natural Gas
BKI.....Bulk Item	NGV Natural Gas Vehicle
CISCoolant Inhibit Solenoid	NP..... Non-Procurable
CNG.....Compressed Natural Gas	NU Not Used
CompuvalveCombined Metering Valve and Computer Assy	O2..... Oxygen Sensor
CPSCanister Purge Solenoid	OEM..... Original Equipment Manufacturer
DIADiameter	P/O..... Part Of
ECT.....Engine Coolant Temperature	PCM Powertrain Control Module
EEC.....Electronic Engine Control	PLCS Places
EGRExhaust Gas Recirculation	PRD Pressure Relief Device
FAPFuel Absolute Pressure	PSI Pounds per Square Inch
FGL.....Fuel Tank Sender (load)	PSIA Pounds per Square Inch - Absolute (Pressure compared to vacuum)
FGM.....Fuel Gauge (meter)	PSIG Pounds per Square Inch - Gauge (Pressure compared to atmosphere approx. 14.7 x PSIA)
FRT.....Fuel Rail Temperature	QTY..... Quantity
FSP.....Fuel Storage Pressure	RET Return
GFI.....Gaseous Fuel Injection	RH Right Hand (passenger's side)
GISGasoline Inhibit Solenoid	RS-232..... Serial Communications Protocol
GND.....Ground	SCFH..... Square Cubic Feet per Hour
GSL.....Gasoline	SW B+..... Switched Battery Power
HEGOHeated Exhaust Gas Oxygen Sensor	TACH..... TACH/RPM Signal
HPSHigh Pressure Solenoid	TDC..... Timing/Spark Advance Signal
IAT.....Intake Air Temperature	TPS..... Throttle Position Sensor
IGNIT.....Switched Battery Power	
INJ.....Injector	

PAINTING AN NGV

When a vehicle is painted, it is placed in a heated room known as a “paint oven” to cure the paint. These rooms typically operate at temperatures up to 140° F. Because of this, it is essential that the CNG cylinder is vented (emptied).

WARNING: *Failure to vent the CNG cylinder may cause an overpressure condition that can be hazardous to personnel and property.*

JACKING OR LIFTING

Most vehicles may be lifted using normal jacking procedures as described in the OEM owner’s manual. It is important that the following additional steps are observed:

- DO shutoff all tank valves before lifting.
- DO NOT use the Natural Gas components (e.g. tanks, tank brackets, covers and fuel lines) as lift or contact points.
- DO NOT allow the jacking to twist or distort the high pressure CNG fuel lines.

TOWING A CONVERTED VEHICLE

Converted Vehicles can be towed using normal towing procedures. Please observe the following additional steps.

- DO shutoff all tank valves before lifting or towing
- DO NOT attach tow bars, towing chains or safety chains to the Natural Gas components (e.g. tanks, tank brackets, covers and fuel lines).
- DO NOT allow tow bars, towing chains or safety chains to rest or rub against the Natural Gas components.
- For vehicles equipped with a tank aft of the rear axle, DO NOT tow from the rear. Tow from the front.

VEHICLES INVOLVED IN ACCIDENTS

Vehicles involved in an accident that may cause damage to the Natural Gas components must be inspected and certified before being returned to service. This includes tank inspection and leak testing as well as system integrity and function.

VEHICLE / SYSTEM IDENTIFICATION

There are a series of labels around the vehicle that identifies it as a Natural Gas Vehicle (NGV) and distinguish areas of special attention. Many of these labels are required by federal and local regulations for the operation of a vehicle with Compressed Natural Gas (CNG). If these labels are damaged or removed for any reason, these labels must be replaced and filled out with the information contained on the original labels.



The CNG diamond identifies vehicles that use CNG as an alternative fuel. This is required by law.

CNG FUELED VEHICLE
Service Pressure:
20700 kPa (3000 psig) L1-200

SEE INSTRUCTIONS ON FUEL CONTAINER OR UNDERHOOD LABELS FOR INSPECTION AND SERVICE LIFE L1-207

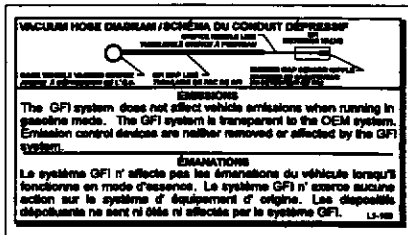
The labels located by the fill receptacle provide necessary information on the system pressure and tank inspection requirements.



The Manual Shut off label is placed on the exterior of the vehicle and is used to identify the location of the quarter turn valve.

NG133

Exterior Labels



		GFI Control Systems, Inc. 100 Highway 69, Unit 200 Cambridge, Ontario, N0B 2C2 Phone: (519) 875-2200 Fax: (519) 875-2200	THIS VEHICLE HAS BEEN EQUIPPED WITH A GFI ALTERNATIVE FUEL RETROFIT SYSTEM. IN GASOLINE MODE, THE GFI SYSTEM DOES NOT AFFECT OPERATIONAL SETTINGS (E.G. SPARK ADVANCE, FLEET SPEED) AND AIR/FUEL MIXTURE. DURING OPERATION WITH AN ALTERNATIVE FUEL, THE GFI SYSTEM CONTROLS THESE SETTINGS AS REQUIRED. NO ADDITIONAL ADJUSTMENTS ARE REQUIRED OR AUTHORIZED. THE RETROFIT SYSTEM MEETS ALL EMISSIONS REQUIREMENTS IN EFFECT AT THE TIME OF INSTALLATION. EMISSION CONTROL DEVICES ARE NEITHER REMOVED OR AFFECTED BY THE GFI SYSTEM AND MUST BE MAINTAINED IN ACCORDANCE WITH THE STANDARD REQUIREMENTS FOR GASOLINE OPERATION. THE GFI SYSTEM MEETS THE FOLLOWING REQUIREMENTS IN EFFECT AT THE TIME OF INSTALLATION:
MODEL YEAR: _____ VIN #: _____ ENGINE MAKE: _____ YEAR MANUFACTURED: _____ ENGINE MAKE (in French): _____ DATE INSTALLED: _____ RELEASE AT INSTALLATION: _____	RETROFIT BY: _____ ADDRESS: _____ CITY: _____ STATE: _____ PHONE: _____ FUEL TYPE: _____ WARRANTY INFORMATION STATE: _____ WARRANTY INFORMATION NUMBER: _____	IN GASOLINE MODE, THE GFI SYSTEM DOES NOT AFFECT OPERATIONAL SETTINGS (E.G. SPARK ADVANCE, FLEET SPEED) AND AIR/FUEL MIXTURE. DURING OPERATION WITH AN ALTERNATIVE FUEL, THE GFI SYSTEM CONTROLS THESE SETTINGS AS REQUIRED. NO ADDITIONAL ADJUSTMENTS ARE REQUIRED OR AUTHORIZED. THE RETROFIT SYSTEM MEETS ALL EMISSIONS REQUIREMENTS IN EFFECT AT THE TIME OF INSTALLATION. EMISSION CONTROL DEVICES ARE NEITHER REMOVED OR AFFECTED BY THE GFI SYSTEM AND MUST BE MAINTAINED IN ACCORDANCE WITH THE STANDARD REQUIREMENTS FOR GASOLINE OPERATION. THE GFI SYSTEM MEETS THE FOLLOWING REQUIREMENTS IN EFFECT AT THE TIME OF INSTALLATION:	L1-202

ALL CNG COMPONENTS MUST BE SERVICED BY AUTHORIZED MECHANICS ONLY L1-203

These labels are located on the underside of the hood. They contain warnings and information required by federal and local regulations and must be on the vehicle.

CNG FUELED VEHICLE

System Identification:

Model: Serial:

No. of Cylinders Installed:

System Pressure @ 70° F:

Total Cylinder Water Volume:

Co. No.: Liters:

Cylinder Inspection Date:

Cylinder Expiration Date:

GFI Control Systems, Inc.
 100 Highway 69, Unit 200
 Cambridge, Ontario, N0B 2C2
 Phone: (519) 875-2200
 Fax: (519) 875-2200
 L1-204

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Underhood Labels

THIS VEHICLE MUST BE OPERATED ON UNLEADED GASOLINE A MINIMUM OF ONE TANK EVERY 60 DAYS

The interior labels provide operating instructions for the vehicle.

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1. SCHEDULED MAINTENANCE

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Section 1. Scheduled Maintenance

Regularly scheduled maintenance is required to ensure that the GFI System performs properly. Failure to maintain the system could result in poor vehicle and emissions performance as well as creating safety concerns for operators, passengers and technicians.

1.1 SCHEDULED VEHICLE MAINTENANCE

The following table represents the scheduled maintenance for the GFI System. This maintenance schedule is based on 6,000 mile increments. Information concerning storage tanks is for reference only and based on tanks that are qualified for NGV2 only, consult local regulations for tanks not rated as NGV2.

ITEM	MILES (x1000)												
	6	12	18	24	30	36	42	48	54	60			
GFI SYSTEM:													
1. Check System Operation	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			
2. Check for CNG Leaks	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			
3. Check Condition of Hoses	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			
4. Check Condition of Wiring	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆			
PRESSURE REGULATOR													
1. Check HP Solenoid		◆		◆		◆		◆		◆			
2. Change Inlet Filter					◆					◆			
GFI COMPUVALVE													
1. Check Injector Operation		◆		◆		◆		◆		◆			
GFI FUEL FILTER													
1. Replace		◆		◆		◆		◆		◆			
COALESCENT FILTER (if Installed)													
1. Drain & Clean	◆	◆	◆	◆		◆	◆	◆	◆				
2. Replace Filter Element					◆					◆			
TANK STORAGE SYSTEM													
	MONTHS												
	12	24	36	48	60	72	84	96	108	120	132	144	156
1. Tank Inspection for Damage	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆

◆ = Required ◇ = Recommended

1.2 SYSTEM MAINTENANCE PROCEDURES

Checking system operation consists of determining that the vehicle operates properly when using Natural Gas. It is recommended that the standard base vehicle maintenance schedule be performed prior to checking the GFI system. A base vehicle problem (such as a weak ignition system) can affect the natural gas system operation before the problem becomes evident in gasoline mode.

MP01	CHECKING SYSTEM OPERATION (perform every 6,000 miles)	ACTION TO TAKE
A.	Perform Required Base Vehicle Maintenance.	<ul style="list-style-type: none"> • Repair As Required
B.	Check System Operation. <ol style="list-style-type: none"> 1. Set fuel selector switch to Natural Gas and start engine. 2. Operate vehicle on natural gas. 3. Diagnosis problem symptom. 	<ul style="list-style-type: none"> • Diagnose problem symptom using specific condition diagnostics
C.	Check for Fuel Leaks.	<ul style="list-style-type: none"> • Use the leak test procedures outlined in section 2 - Repair As Required
D.	Check Condition of Hoses. <ol style="list-style-type: none"> 1. Coolant hoses must be checked for signs of leakage, weather cracking and brittleness. 2. Fuel hoses must be checked for signs of leakage, weather cracking and brittleness. <p>NOTE: <i>These hoses have a special crimped fitting on the ends and must be replaced with original equipment replacements.</i></p> <ol style="list-style-type: none"> 3. Check condition of vent hose from regulator. <ol style="list-style-type: none"> a) Check for obstructions in hose. b) Check hose for cracks and if soft and pliable. 	<ul style="list-style-type: none"> • If leaks are detected at ends of hose - tighten clamps as required • If hoses appear cracked or no longer soft and pliable - replace hose • If hoses appear cracked or no longer soft and pliable - Replace Hose Assembly • Thoroughly clean hose as required • Replace As Required
E.	Check Condition of Wiring. <ol style="list-style-type: none"> 1. Check that connectors are securely assembled. 2. Check wiring for breaks, shorts or fraying. 3. Check wiring is secure - not loose or hanging. 	<ul style="list-style-type: none"> • Repair As Required
MP02	PRESSURE REGULATOR	ACTION TO TAKE
A.	Check HP Solenoid (perform every 12,000 miles). <ol style="list-style-type: none"> 1. Disconnect connector P3 from regulator. 2. Measure the resistance between pins F and D of P3 (connector from regulator). 	<ul style="list-style-type: none"> • If value is not between 6 to 8 ohms - replace solenoid coil
B.	Change Inlet Filter (perform every 30,000 miles or as required). <ol style="list-style-type: none"> 1. Bleed system (refer to "Working with the High Pressure System"). 2. SLOWLY crack open line fitting on regulator - allow any natural gas left in system to escape. 3. Remove hardline from regulator. 4. Remove Special Inlet Fitting from regulator. 5. Discard existing filter, spring and O-ring. 6. Clean fitting and orifice in regulator. 7. Reassemble fitting with new filter kit. 8. Reattach hardline. 9. Check for leaks. 	<p>WARNING: <i>This operation requires working with the high pressure system. Extreme care must be exercised. The cautions and warnings must be followed to ensure safety.</i></p>
MP03	GFI COMPUVALVE	ACTION TO TAKE
A.	Check For Compuvalve Injector "Leak Thru" <ol style="list-style-type: none"> 1. Turn Ignition Key Off then ON <ol style="list-style-type: none"> a. Record FAP value b. Wait 2 minutes and record new FAP value 	<ul style="list-style-type: none"> • If FAP Drops more than 10 psia - Recheck System for Leaks - Repair As Required. • If No External Leaks Found - Replace Compuvalve

Section 1. Scheduled Maintenance

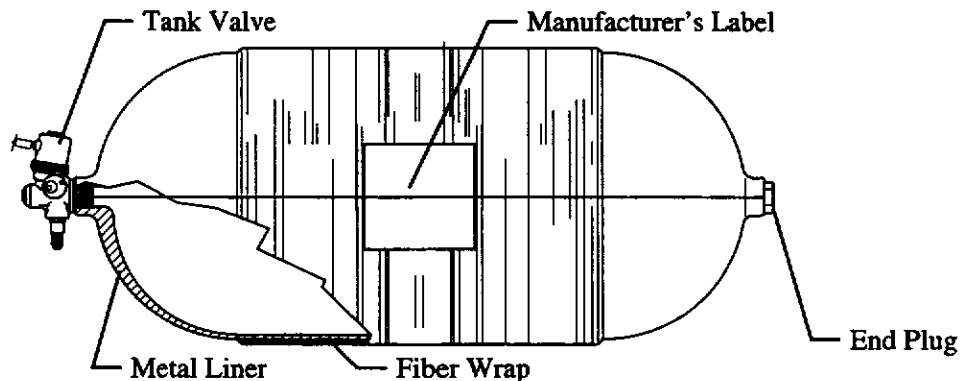
GFI Natural Gas Service Manual

MP04	LOW PRESSURE GFI FUEL FILTER	ACTION TO TAKE
<p>A. Replace GFI Fuel Filter (perform every 12,000 miles). NOTE: <i>The GFI fuel filter is not interchangeable with standard gasoline filters.</i></p> <ol style="list-style-type: none"> 1. Bleed system pressure. 2. SLOWLY loosen filter fitting - allow gas left in system to escape. 3. Remove filter. 4. Install new filter 9. Check for leaks. 		<p>WARNING: <i>This operation requires working with the high pressure system. Extreme care must be exercised. The cautions and warnings must be followed to ensure safety.</i></p>
MP05	HIGH PRESSURE COALESCENT FILTER (if installed)	ACTION TO TAKE
<p>A. Drain and Clean Inline Filter (perform every 6,000 miles).</p> <ol style="list-style-type: none"> 1. Bleed high pressure system. Refer to Section 5. 2. SLOWLY loosen filter inlet fitting - allow any natural gas left in system to escape. 3. Remove plug and drain liquid contaminate. 4. Remove filter bowl and filter element. 5. Thoroughly clean bowl, drain and filter element with mild soap and water solution or similar cleaner. Hand clean only, DO NOT use solvent or parts cleaning machines. Allow parts to dry thoroughly. 6. Reassemble filter. 8. Tighten fitting loosened in step 2. Check for leaks. 		<p>WARNING: <i>This operation requires working with the high pressure system. Extreme care must be exercised. The cautions and warnings must be followed to ensure safety.</i></p>
<p>B. Replace Inline Filter Element (perform every 30,000 miles).</p> <ol style="list-style-type: none"> 1. Bleed high pressure system. 2. SLOWLY loosen filter inlet fitting - allow any natural gas left in system to escape. 3. Remove plug and drain liquid contaminate. 4. Remove filter bowl and filter element, discard filter element. 5. Thoroughly clean bowl and drain with mild soap and water solution or similar cleaner. Hand clean only, DO NOT use solvent or parts cleaning machines. Allow parts to dry thoroughly. 6. Reassemble filter using new replacement filter element. 8. Tighten fitting loosened in step 2. Check for leaks. 		<p>WARNING: <i>This operation requires working with the high pressure system. Extreme care must be exercised. The cautions and warnings must be followed to ensure safety.</i></p>
MP06	LOW PRESSURE COALESCENT FILTER (if installed)	ACTION TO TAKE
<p>A. Drain Inline Filter (perform every 2,000 miles).</p> <ol style="list-style-type: none"> 1. Bleed high pressure system. Refer to Section 5. 2. SLOWLY loosen filter inlet fitting - allow any residue natural gas pressure in system to escape. 3. Remove plug and drain liquid contaminate. 4. Reinstall Filter Plug. 5. Tighten fitting loosened in step 2. 6. Check for leaks. 		
<p>B. Replace Inline Filter Element (perform every 6,000 miles).</p> <ol style="list-style-type: none"> 1. Bleed high pressure system. 2. SLOWLY loosen filter inlet fitting - allow any residue natural gas pressure in system to escape. 3. Remove plug and drain liquid contaminate. 4. Remove filter bowl and filter element, discard filter element. 5. Thoroughly clean bowl and drain with mild soap and water solution or similar cleaner. Hand clean only, DO NOT use solvent or parts cleaning machines. Allow parts to dry thoroughly. 6. Reassemble filter using new replacement filter element. 7. Tighten fitting loosened in step 2. Check for leaks. 		

1.3 TANK STORAGE SYSTEM INSPECTION

The tank used for natural gas is designed and manufactured to meet requirements of NGV2. This is a series of standards as adopted by the American National Standards Institute (ANSI) and the American Gas Association (AGA). This standard contains specifications for the material, design, manufacture and testing of serially produced, refillable Type NGV2 containers intended only for the storage of compressed natural gas for vehicle operations.

The two most common types of tanks are NGV2-1 or metal tanks and tanks that are graded as NGV2-2 type tanks. This means the construction of the tank consists of a metal liner reinforced with resin impregnated continuous filament. The filament is "hoop wrapped" which means that the winding of filament is done in a substantially circular pattern around the cylindrical portion of the liner.



Two other types of tanks for NGV2 are available. NGV2-3 are tanks with metal liners that are fully wrapped with resin impregnated continuous filament and NGV2-4 are tanks with non-metallic liners that are fully wrapped with resin impregnated continuous filament.

Tanks may be rated for use at 3000 psi or 3600 psi. **Tanks should never be overpressurized.**

If damage to the tank is observed during maintenance/repair, the tank must be inspected and approved by qualified personnel. If the tank is rejected, the tank must be replaced before the vehicle is returned to service.

FOR INSTALLATIONS BEFORE SEPTEMBER, 1996, THE TANK MUST BE VISUALLY INSPECTED EVERY 36 MONTHS TO MAINTAIN COMPLIANCE WITH NGV2 STANDARDS. FOR INSTALLATIONS AFTER SEPTEMBER, 1996, VISUAL INSPECTIONS ARE REQUIRED EVERY 12 MONTHS.

WARNING: *A tank that does not pass the inspection criteria must be replaced before the car is returned to service using Natural Gas.*

1.3.1 VISUAL INSPECTION

The visual inspection is for external damage and deterioration. The inspection must be performed by QUALIFIED PERSONNEL in accordance with the manufacturer's established inspection criteria and the procedures outlined in pamphlet C-6.2 from the Compressed Gas Association (CGA).

The CGA publication may be ordered from: CGA Publications
 1725 Jefferson Davis Highway, Suite 1004
 Arlington Virginia 22202-4102
 Phone: (703) 412-0900 ext. 799
 FAX: (703) 412-0128

QUALIFIED PERSONNEL are those that are so designated by the Department of Transportation and prevailing authorities responsible for containers used to carry, contain and/or transport gas, hazardous materials and similar materials.

1.3.2 UPDATING LABELS

CNG FUELED VEHICLE

System Identification:
Model: 021001009 Serial:
No. of Cylinders Installed:
System Pressure @ 78° F:
Total Cylinder Water Volume:
Gals. In.: Liters:
Cylinder Inspection Date:
Cylinder Expiration Date:

GFI
GFI Control Systems, Inc.
108 Hollinger Crescent, Kitchener
Ontario, Canada, N2K 2Z2
Phone: 1-800-637-6378
FAX: (519) 874-6916
1.3.208

Cylinder Inspection Date:
NEXT INSPECTION DATE

The labels that identify the tank system must be updated after the tanks have been inspected.

For the underhood label, an update sticker is available that is pasted over the existing label.

1. Use an impact style typewriter and fill in the next required inspection date (month & year) in the block area provided on the update/new label. Required inspection dates are every 36 months from the date shown on the label (not the date of inspection).
2. Clean the existing label area and affix the new label in position over the old inspection date.
3. Refer to the Illustrated Parts Catalog for part number of update/new labels.