



**DRIVING INTELLIGENT  
VEHICLE SOLUTIONS**



# Alternative Fuel Solutions

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## LPG System Training

*A Spartan Motors Company*





# Propane 101



- Propane is a safe and widely used fuel. It is sometimes called liquefied petroleum gas, LP gas, or LPG.
- Propane will not ignite when combined with air unless the source of ignition reaches 920 degrees Fahrenheit. (Gasoline ignites at 495 degrees Fahrenheit).
- Propane gas is nontoxic and produces minimal emissions.
- Propane is not harmful to soil or ground water.
- Over 95% of the propane used in the United States is produced in North America.
- Propane autogas has the most developed refueling infrastructure of any alternative fuel in the United States.

# Propane 101



Propane produces:

- ✓ 60% less carbon monoxide emissions
- ✓ 40% fewer smog-producing hydrocarbons while fueling
- ✓ 20% less nitrogen oxide at tailpipe
- ✓ 12% less carbon dioxide at tailpipe



# Chassis Assembly



NPR Gas – cab set

Dyno verification



# Spartan Motors - Campus



Vehicle Modification  
Center



# Plant 4 – Vehicle Modification Center



## Isuzu PIO

(Port Installed Options)

- Mirrors
- Mud flaps
- Isuzu Badge
- Radio
- Chrome Wheels
- ..... etc

## Upfit:

- Propane Conversion
- CNG Conversion
- Custom Isuzu dealer requests - custom upfit)



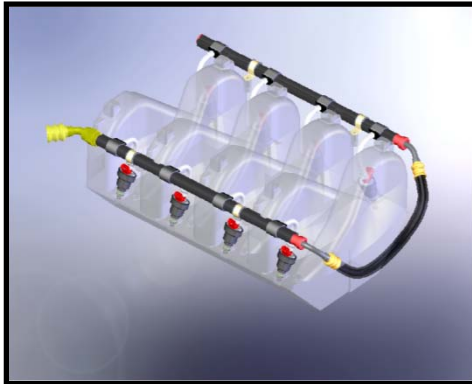


# Conversion Process



## 1. Remove Gasoline:

- Injectors
- Fuel Lines
- Evap System
- Fuel Tank



## 2. Install LPG:

- Fuel Rail w/Injectors
- Tank/Supply Line/Fuel Gauge/Filter
- Wiring Harnesses
- Calibration Software
- Add Fuel!

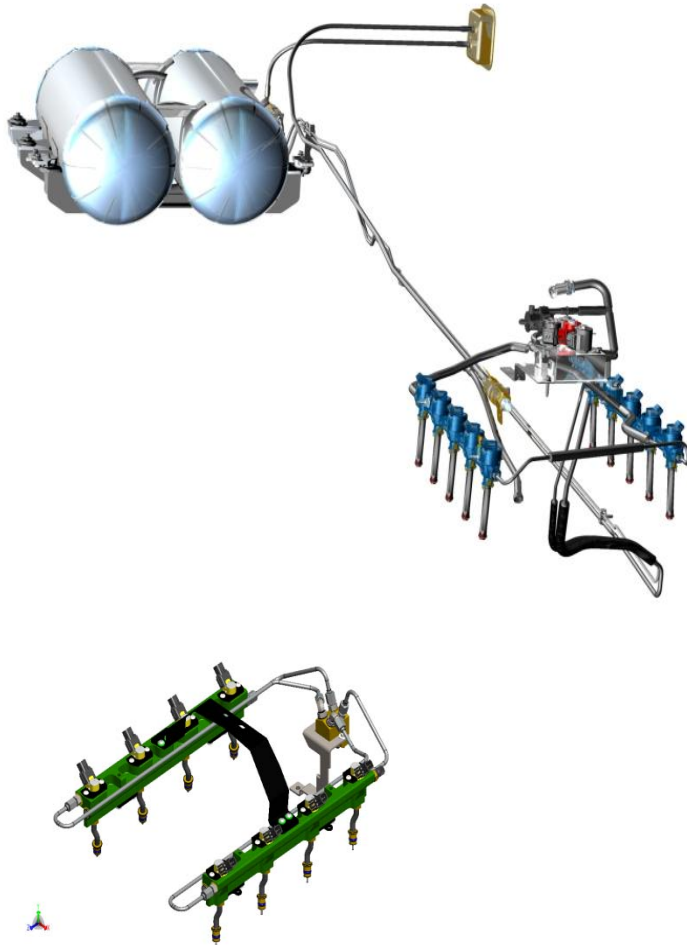


## 3. Perform Quality Checks

- Fuel Rail PSI
- Pump/Evac
- IDSS Values
- Drive Test



# Bi-Phase LPEFI System Function



- Dedicated multi-port fuel injection system. Standard conversion is a single tank system.
- Propane is injected in a liquid state.
  - eliminates vaporizers or regulators.
  - reduces problems such as backfires.
- Purge feature advances liquid fuel to injectors for improved starting performance.
- Fuel injectors are a proprietary Bi-Phase self-cooling design and engineered for liquid propane. They are 100% compatible with stock controls.
- System uses tanks equipped with custom engineered mounting for Liquid Propane Delivery Module (LPDM) and bolt-on frame installation.
- No loss in HP, torque or towing.
- Simple, familiar technology.

# Bi-Phase LPEFI Purge Feature



The Bi-Phase Purge feature advances liquid fuel to the injectors for improved starting performance.

- When vehicle is shut off, the liquid propane in the fuel rails will eventually expand and turn to vapor which can make starting difficult.
- The Door Purge feature becomes active 10 minutes after the vehicle is parked and the driver door is closed.
- When the driver door is opened, the door switch signal triggers the pump to send liquid fuel to the fuel rails, which returns the unburned propane vapor to the storage tank.
- The fresh liquid fuel supplied to the injectors greatly improves startability of the vehicle.

# The Bi-Phase LPEFI System



- The Bi-Phase *LPEFI* system is a direct replacement propane fuel injection system. It replaces the gasoline fuel injection system and works the same as a gasoline fuel injection system with the exception it injects propane, in a liquid state, into the intake port.
- The electronic engine management system is still used to control the LPEFI system, just as it did the gasoline injection system. Onboard diagnostics remain unchanged so the same scan tool and diagnostic approach as a gasoline system can be used. However, the ECM program is proprietary to Bi-Phase and IS NOT interchangeable with the gasoline ECM program. If the gasoline ECM program is installed this will result in drivability issues on an LPG-equipped vehicle, and a re-flash to the Bi-Phase software will be required.
- The *LPEFI* system consists of three main components: the tank, the fuel lines and the injectors. The tank is located to the rear or middle of the vehicle and the lines are routed forward to the engine compartment where the injector rail assemblies are mounted in the same position as the original gasoline injector rails were installed.



# Bi-Phase LPEFI Main Components

## The Tank

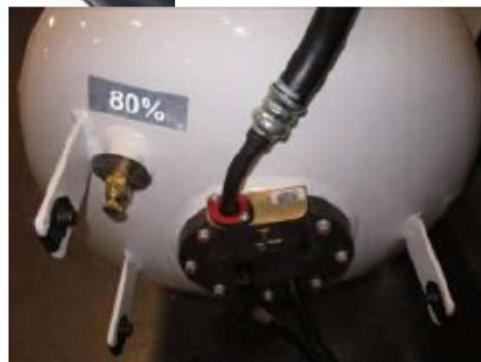
- The fuel tank includes an internal electric fuel pump & filter, fuel supply & return valves, baffle that keeps the pump submerged in liquid propane and various other valves, fuel level float assembly, pressure relief valve, overfill prevention device, and liquid service valve.



# Bi-Phase LPEFI Main Components

## The Fuel Lines

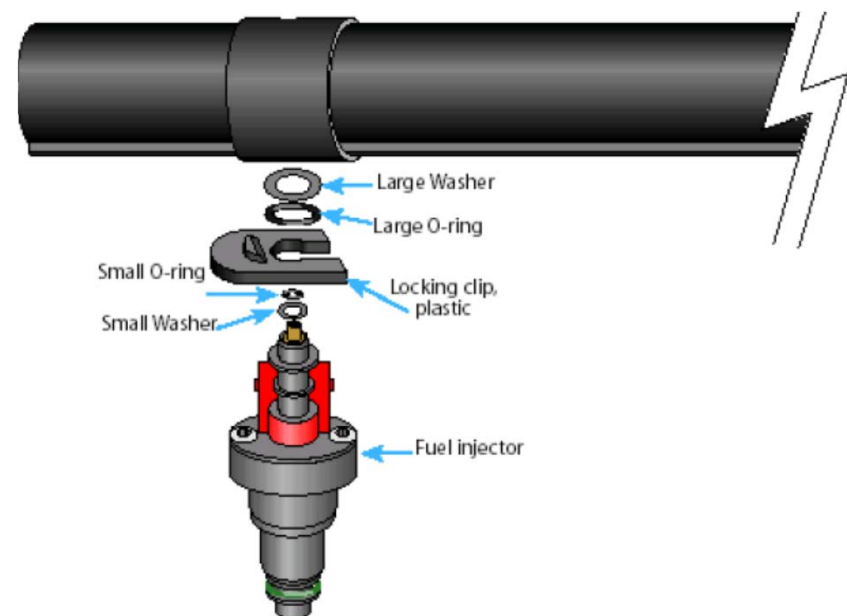
- The fuel lines consist of two flexible hoses, one inside the other, in a concentric arrangement. The nylon inner line supplies liquid propane to the injectors while the area between the outside of the inner line and the larger outer hose is the fuel return passage. The amount of stick-out typically does not require adjustment, and the ends of the inner hose should NEVER be modified under any circumstances.



# Bi-Phase LPEFI Main Components

## The Injectors

- The *LPEFI* system injectors are designed specifically for liquid propane. They mimic the gasoline fuel injectors that they replace.
- The injector delivers propane in a liquid state into the intake port. It vaporizes immediately upon exiting the injector. This rapidly expanding liquid cools the incoming air to the engine often resulting in a little more horsepower than the gasoline system could achieve, not to mention the inherently improved exhaust emissions that propane is known for.





# Propane Safety

- ⚠ Never loosen fittings or vent any propane. Escaping propane can cause frostbite and severe freeze burns.
- ⚠ Wear insulated PVC rubber gloves resistant to propane.
- ⚠ Wear Goggles for protection against accidental release of pressurized products and thermal protective clothing when handling refrigerated liquids.
- ⚠ Do not remove any valves, bulkheads, or fittings from a tank unless the tank has been drained completely. The pressure inside a propane tank can push a loosened bulkhead or valve out with enough force to cause injury or death.
- ⚠ Keep all sources of ignition away from propane vehicles while the fuel system is being serviced. Even if the tank and fuel lines are empty, there may still be flammable vapors near the vehicle.

# Propane Safety

- ⚠ Do not allow smoking, sparks, flames, recent or running vehicles or other sources of ignition when fueling, servicing and vented propane. Failure to do this could result in fire or explosion, causing severe property damage, injury or death.
- ⚠ Do not disconnect any propane hoses unless they have been properly drained completely.
- ⚠ Do not vent or release propane indoors or near sewers, pits or low lying areas. Propane can accumulate in low spots, creating a fire hazard. Propane can also displace oxygen, creating a suffocation hazard.

# Service Shop Modifications



- Are modifications required for my shop?
- Determine type of repairs performed in service area:
  - Major Repairs = Repairs involving fuel systems, open flames / welding, engine overhauls, painting, body work, and draining fuel systems.
  - Minor Repairs = All other repairs including lubrication, engine tune-ups, parts replacement, fluid changes, brake service, tire rotation, regular maintenance work.



# Service Shop Modifications



- If Major repairs are performed in the service area these fire code requirements apply:
  - Ventilation systems
  - Gas Detection systems
  - Ignition Source Temperature limits
  - Electrical Classification
- If only Minor repairs are performed in the service area, modifications to the service area are not required.
- For more details, refer to:  
<http://www.cleanvehicle.org/committee/technical/PDFs/GuidelinesDocumentFinal.pdf>

# Online LPG Technical Resources



[www.utilimaster.com/manuals](http://www.utilimaster.com/manuals)

- Diagnostic Manual
- Shop Safety
- Troubleshooting Guide
- Warranty Guide

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### TECHNICAL MANUALS

Utilimaster is with you for the life of your vehicle. Our Customer Product Support Group manages the creation of a variety of technical manuals to assist you in operating and servicing your vehicle. These manuals are in Adobe Acrobat PDF format for easy opening, maneuvering and printing.

Utilimaster has also created technical videos to assist with vehicle operation and component installation. Please check back frequently as our video library continues to grow.

### Video Support

### ALTERNATIVE FUELS

- CNG: Service - Shop Safety (Isuzu NPR Chassis)
- CNG: Service Tools (Isuzu Chassis)
- LPG: Diagnostic Manual
- LPG: Service - Shop Safety (Isuzu NPR Chassis)
- LPG: Troubleshooting Guide (Isuzu Chassis)
- LPG: Warranty Guide & Claim Form (Isuzu Chassis)
- CNG: Troubleshooting Guide (Isuzu NPR Chassis)
- CNG: System Service Manual
- CNG: System Owner's Manual

### OPERATORS GUIDES

- Operators Guide - All Products
- Operators Guide - Reach

### PARTS MANUALS

**Aeromaster**

- Parts - Aeromaster - Ford - 1997-2002

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# Common Service Needs Solutions



- **ECM Reflash Is Required** Programming is proprietary to Bi-Phase and model year unique to the LPEFI system installed on the Isuzu NPR 6.0L engine with gaseous prep package. It is NOT interchangeable with the normal gasoline ECM program. If LPEFI vehicle is flashed with gasoline program, re-flash to LPG program is required.
- **Misfire at Isolated Cylinder Location** Perform “Fuel injector Check” and “Ignition Checks” per Bi-Phase Diagnostics Manual, October 2012, page 14-15. If needed, replace injector per Bi-Phase Diagnostics Manual, October 2012, page 35-36, “R & R Injectors or Injector Rail Complete”.
  - **Compression Check** Perform with a compression gauge, vacuum gauge or an engine analyzer. Compression pressures are considered within specification if the lowest reading cylinder is 75 percent of the highest reading cylinder (within 25%).

# Fuel Line Common Solutions



- When Lean Fuel Condition Persists at Injector or at Multiple Injectors Check Boost Pressure (per Bi-Phase Diagnostics Manual, October 2012, page 12).
  - **High Boost Pressure in Fuel Lines (above 50-55 psi)** Check primary hose for internal line kinks. If hose is known to have been folded or flattened, replace Primary Hose as this will disrupt normal flow.
  - **Low Boost Pressure in Fuel Lines (below 30-35 psi)** Check seating of inner line of Primary Hose. Ensure that both the rail end and the tank end have at least approximately 1.5 inches of inner hose stick-out. Adjust inner hose stick-out length if required, or replace hose.
- **CAUTION:** Modification of the Primary Fuel Line inner hose will void warranty coverage for this component. Modification includes: Trimming, chamfering, bending, forming, changing diameter, etc.



# Service Intervals

Fuel fill filter – Change every 30,000 miles



- Change Fill Filter (located between the remote fill valve receptacle & the overfill prevention device located on the tank, and inline with the hoses).
  - 1. Slightly loosen one flare nut on the fill filter using  $\frac{3}{4}$ " wrench to prevent filter from turning – cold liquid propane will spray out until the fill filter and fill hoses are empty (this should take less than a minute). Fully loosen when line pressure fully vents.
  - 2. Loosen other flare nut on the fill filter and remove both hoses from the fill filter.
  - 3. Remove the hold down clamp on the fill filter and remove the fill filter
  - 4. Install new fill filter in the marked direction of flow; arrow pointing to the tank or inlet pointing to the remote fill valve receptacle & replace hold down clamp & bolt.
  - 5. Using  $\frac{3}{4}$ " wrench to hold the filter in place, tighten the flare nuts to 10-15 ft-lb.
  - 6. Refuel the tank & check all fittings for leaks and fully tighten flare nuts. Use approved leak detection fluid to check for leaks or use an electronic combustible gas detector.

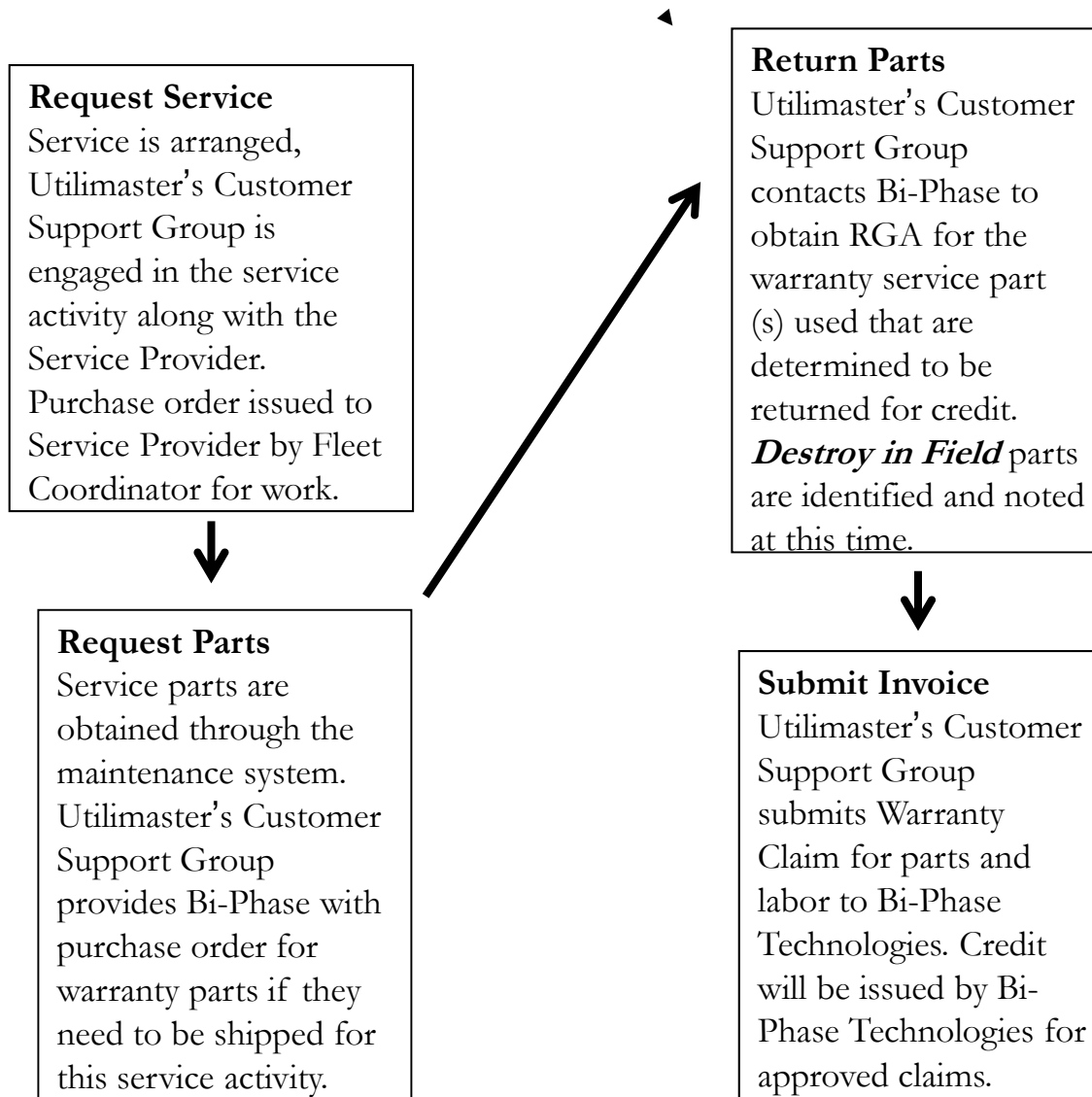
Note: Fill hoses & filter must be drained, but not main fuel line or tank. A double back-check valve in the tank prevents fuel from escaping through the fill hoses. Tank does not need to be drained.

# Warranty



- **If Warranty Service or Parts are Required** Customer or dealer should call **Utilimaster Technical Support** at **(800)237-7806** and select option for Customer Product Support/Warranty. Utilimaster will coordinate parts delivery.
- Bi-Phase Components Covered (per LPG Warranty Guide):
  - Fuel Injectors
  - Fuel Injector Rails
  - LPDM, Liquid Propane Delivery Module (includes fuel pump)
  - Fuel delivery hoses
  - Fuel delivery control module/tank control box
  - Fuel Tank(s) including all valves and appurtenances
- Note that maintenance items such as filters are not covered under this warranty. Maintenance items are at the owner's expense.
- 5 Year/75,000 mile limited warranty

# Warranty Policy Flowchart



# Required Service Tools



Three switch box: Allows a technician to manually operate the tank fuel supply valve, fuel return valve and fuel pump. A built-in ammeter displays the total current consumed by the fuel pump and valves



Pressure gauge: This pressure gauge testing kit is equipped with a quick connect Schrader Valve connector which allows for easy connection and safe disconnect without releasing any fuel trapped in the hose. A valve on the gauge tee allows the technician to bleed the fuel from the hose outside in a safe location, instead of uncontrolled release in the service bay.

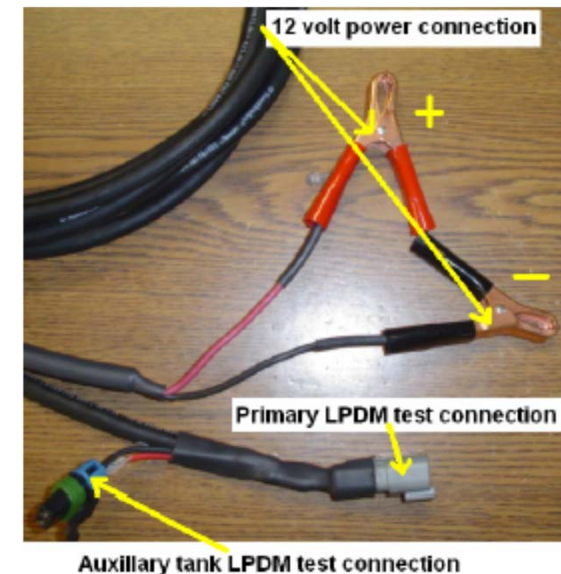


Torch kit: Used to burn the propane vapor in the fuel tank and transfer fuel from one tank to another.

# Service Tools

## Part Numbers

- 271283 – 3-way switch box
- 271175 – Pressure Gauge set
- 271157 – Vapor burner kit





# Replacement Parts

## Common Replacement Parts

- 271202 – Fill Filter
- 271302 - 6.0L Injector
- 271705 – Fuel Level Sender
- 271305 – Primary Hose, 144”

## Uncommon Replacement Parts

- 271306 – Loop hose
- 271333 – Fuel Pump
- 271349 – Primary LPDM
- 273726 – Fill Valve
- 271309 – Control Box
- 273579 – Relay

# Contact Information



## Vehicle Modification Center Hotline:

574.848.2201

## Technical Support Hotline:

800-237-7806

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# Questions?

