



Upgrade Kit: UPGRADE ACCESSORY FOR LIQUID-FUEL ENGINE PURGE

ALL Power Labs Technical Bulletin: #TB-795-00013

Release Date: August 2016

Subject: Liquid fuel injection system to allow purging of engine.

Models: PP20,

Symptom: Poor engine compression and increased maintenance of engine due to corrosion and contamination.

Cause: Depending on details such as your ambient conditions, power levels, type and moisture content of feedstock, condition of the filters etc. the level of vapors and tars in the syngas (SG) that enters the engine can damage or cause sticking of internal engine parts. Most of these problems happen after running while the machine is shut off as the syngas, still inside the engine, cools and condenses.

Action: Purge the engine by running it on liquid fuel. After running on syngas, and while the system is still hot, start and run the engine on Gasoline or Gasohol (E85) using the liquid-fuel engine purge (EP) accessory (APL Part # 870-00087 rev A) to wash out the tars and condensates and prevent them from building up while the engine is stored.

NOTE: When purging a hot/warmed-up engine, a 10 minutes run time should be effective. On a cold engine it may take over 15 minutes to ensure the engine is fully warmed up. You can tell when the engine is at full operating temperature when the engine thermostat opens causing the top tank of the radiator to get almost too hot to touch.

Safety: Gasoline is highly flammable and toxic, use all normal precautions when using the Purge System. Always follow the warnings and instructions listed below:



WARNING

AVOID SPILLING OR LEAKING FUEL ON ENGINE

- Never run a PP unattended on liquid fuel
- Make sure the injection unit is tightly secured
- Keep tank on ground when operating or filling
- Do not operate if any leakage is detected
- Always disconnect and remove after operation
- Do not rest injection unit on PP when not in use
- Make sure switch is off after operation
- Make sure fill cap is on tightly when operating



GASOLINE

EXTREMELY FLAMMABLE LIQUID AND VAPOR

- Keep away from heat, spark and open flames.
- NO SMOKING
- Use only in well-ventilated area
- Avoid contact with skin, eyes, mouth & clothing
- Avoid breathing vapors
- May be fatal if swallowed and enters airways
- Causes skin irritation - If contact is made, wash immediately with soap and water

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



Engine Purge System:

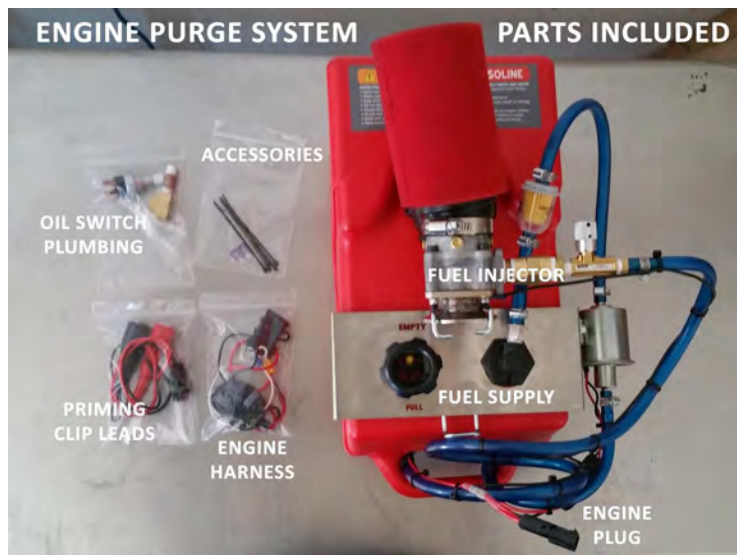


Fuel Supply with attached Fuel Injector Unit:



Parts List: APL Part # 870-00087 A - Liquid Fuel Engine Purge Accessory

APL Part #	Description
820-00248 A	Oil Pressure Switch Plumbing Upgrade
185-00016 A	Replacement Oil Pressure Safety Switch
820-00247 A	Engine Wiring Harness
145-00014 A	Replacement Fuse, 3A, ATC
820-00245 A	Fuel Supply Subsystem
461-00310 A	Replacement Fuel Pump
490-00064 A	Replacement Fuel Hose
445-00195 A	Replacement Fuel Filter
820-00246 A	Fuel Injector Assembly (attached)
445-00039 A	Replacement Air Filter, Foam
820-00249 A	Fuel Supply Wiring Harness (attached)
820-00250 A	Priming Clip Lead Harness



The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

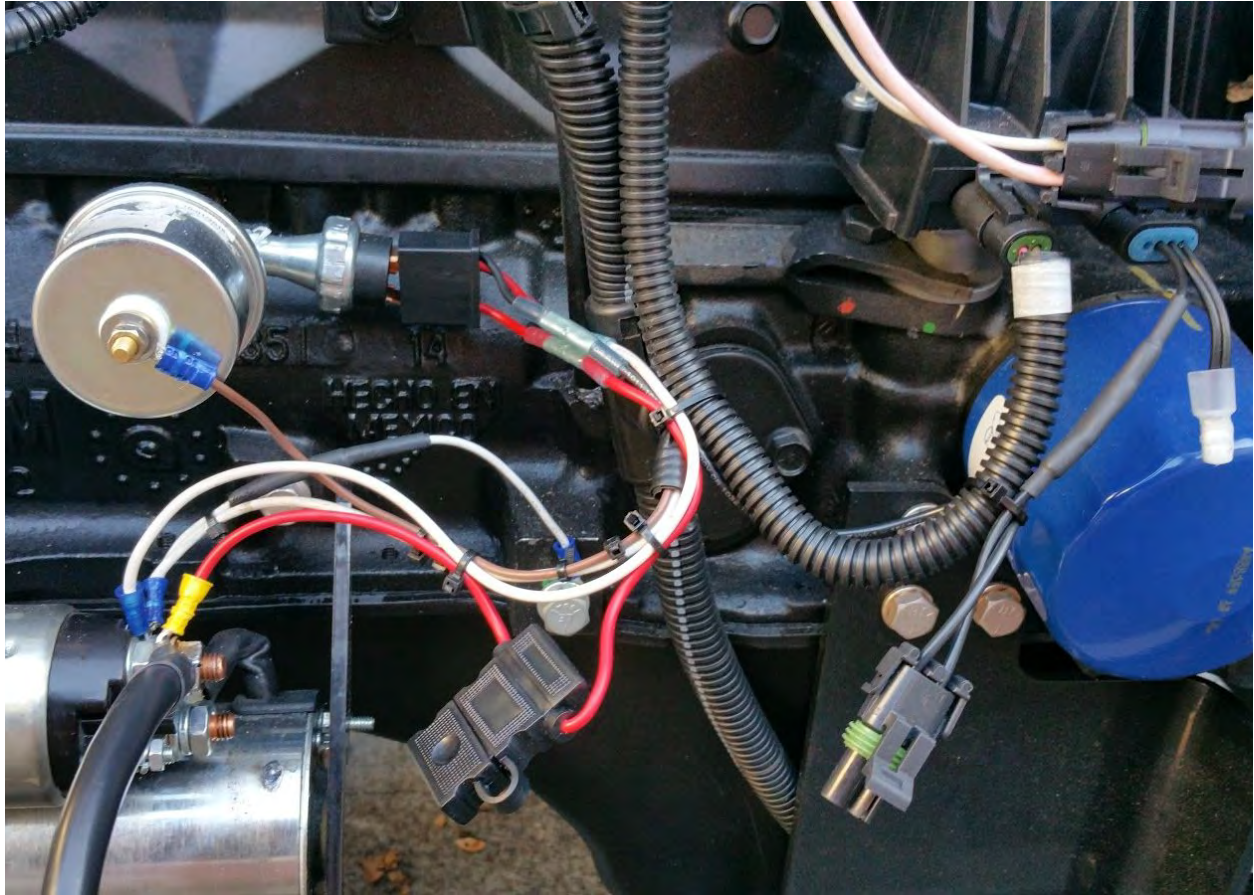
1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



Installation of Engine Modifications: Completed engine installation is shown below:



NOTE: Power Pallets may have various engine wiring harness layouts. Once installed, you will want to use the included zip-ties to secure the upgrade harness to your existing harness in a way that is secure and free from any sharp edges or chafe points.

Required Tools:

8mm (5/16") combination wrench,

13mm (~1/2") combination wrench

14mm (~9/16") combination wrench

Channel lock (Groove Joint/Waterpump pliers), Vicegrip or pipe wrench

PTFE tape or pipe paste

Screw Extractor (included)

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



1. Install Oil Pressure Safety Switch plumbing modification upgrade (APL Part # 820-00248 A).



1A. Remove the 8mm nut and brown wire from the existing oil sender, and remove the sender using the 14mm open end wrench.



1B. Remove the coupler from the sender together with the small pipe nipple that was threaded into the engine block, and discard.



1C. If the nipple stays in the block, remove it using the included screw extractor. Tap it lightly into the pipe nipple and use the 8mm wrench to turn CCW.



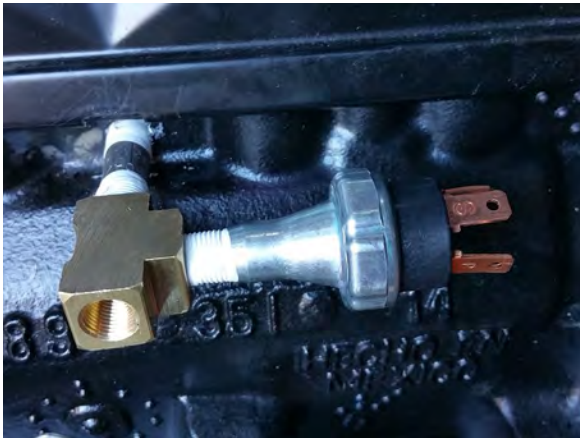
1D. Thread the new brass tee with nipple into the engine block and tighten with the side outlet of the tee facing forward. Being careful not to cross or damage the threads, and keeping all debris out of the engine block.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



1E. If needed apply PTFE to threads and install the new Oil Pressure Safety Switch (APL Part # 185-00016 A) into the side outlet.



1F. Reinstall the original oil pressure sender with new PTFE if necessary into the remaining open port in the tee, and reconnect its wire.

NOTE: Tightness and sealing of NPT connections must be judged by whether or not they leak. After running the engine, check for any leaks and tighten just until the leaks stop and parts are aligned. Do not over tighten.

2. Install EP Engine Harness (APL Part # 820-00247 A) onto the engine:



2A. Attach the black 3-wire plug to the oil pressure sender. Note: plug will not be able to bottom out on the switch and some slight bending of the terminals will occur.



2B. **NOTE: Disconnect a terminal on battery.** Then remove the upper 13mm nut on the back of the starter solenoid along with the large battery cable.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



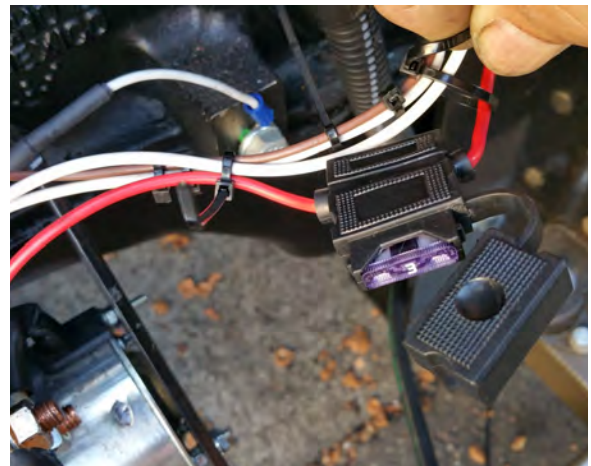
2C. Remove the 8mm nut on the small stud on the back of the starter, and install the white wire with small ring terminal on top of the one already there, and replace the nut.



2D. Install the red wire's large ring terminal onto the starter stud, then the battery cable over it along with the nut. Do not over tighten, these studs need to be just snug, not torqued down.



2E. Plug the timing adjust plug with the blue gasket into the open socket on the distributor. This connection will automatically readjust the timing for gasoline.



2F. Check to make sure there is an intact 3A fuse in the fuse holder and use the supplied zip ties to carefully route and secure the wires. installation of the engine components is complete.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

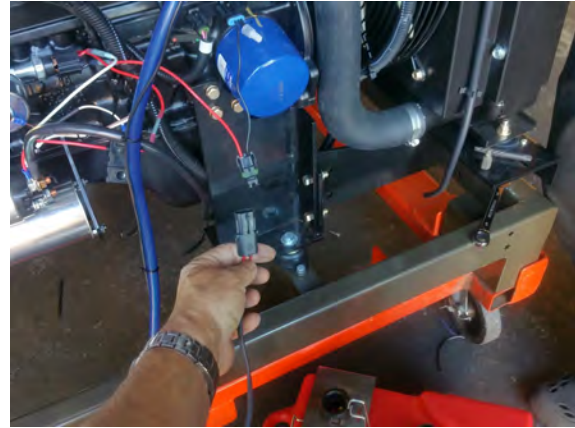
Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



3. Installation of Purge System: Self contained fuel injector with attached 11 liter (3 gal) fuel tank and pump gets connected to the Power Pallet each time a purge is needed and removed afterward.



3A. Disconnect the syngas-supply corrugated gas line from the top of the governor, and securely attach the Fuel Injection unit onto the top of the governor in place of the gas line.



3B. Insert the wiring plug of the Fuel Supply Subsystem from the portable gas tank into the open plug of the Engine Harness.

4. Priming and Bleeding Purge System: This is only for first operation or after running the tank dry.
NOTE: Make sure the needle valve is open at least one full turn before priming or running.



4A. Open the vent in the tank's fill cap by turning counter clockwise only a few turns. Always remember to reclose when moving or storing the fuel tank.



4B. Detach the fuel pump's plug on the Fuel Supply and attach the Clip Lead harness to the pump's plug.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



4C. Clip the leads, red to the large stud on back of starter, black to bare metal on the engine, pump will start. Watch the fuel fill the hose, and remove clips as soon as all air is purged.



4D. **NOTE: Never plug the Clip Lead Harness into the engine plug on the Fuel Supply.** Disconnect the Clip Lead plug from the pump and reattach the plug tied to the hose. Retain the clip lead harness for future use.

Warning: running prime for too long may flood the engine and prevent it from starting.

NOTE: While the system will self-prime once starter is engaged, without priming, the starter would have to run for a long time, unnecessarily straining it, so we recommend using this manual prime procedure.

Operation:

Engine should be purged for a minimum of a 5 minutes immediately following shut down at least once a week or whenever your Power Pallet is expected to be unused for more than 24 hours. More frequent, longer usage may help extend the life of the engine and reduce maintenance depending on your specific use case. If running on a cold engine, allow the engine to reach full operating temperatures (~15 min.)

Notes:

1. Make sure there is adequate fuel (~1 gal per 15 min of purge) in tank, and that the vent is open.
2. When run, exhaust heat will pyrolyze feedstock in the reactor and generate a lot of gas. Best practice for running the engine on liquid fuel is to do it while flaring a hot but cooling reactor immediately after shutdown. This assures that these gases are cracked and burned off in the flare.
3. If you are unable to run the flare, but need to run a purge cycle, feedstock may be vacuumed or otherwise completely removed from the top of the reactor above the hearth.
4. Preadjust the manual fuel mixture knob to an initial setting ~12 for a warmed-up engine and ~25 for a cold engine.
5. Current system is not optimized to allow full dual-fuel operation with electrical load, but is intended primarily as a maintenance procedure under no or minimal load. (1KW - 5KW).



The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



Starting the Engine:

Once the Purge System is attached, start the engine as normal. The pump should start automatically and only run when the engine is running and the Fuel Injector unit is clamped to the engine.

Fine Tuning the Fuel Mixture Trim:

Small variations between systems may require that you tune the mixture for your PP when you first run it. If you have just shut down after a run of more than 30 min, your engine will be at full operating temperature, which is needed to fine tune the warm mixture setting.

NOTE: Running slightly rich allows the excess fuel to improve cleaning ability of the purge cycle, and is preferred for this purge purpose to the normal slightly lean fuel trim.

1. **Cold Engine:** When starting a fully cooled down engine (over 3 hours since the last run) the mixture may need to be enriched considerably for the first few of minutes of operation.
 - a. Climate will affect cold mixture, the colder it is, the richer it needs to be.
 - b. At the initial setting of 25, if the engine fails to start, increase it in small steps (one increment or 1/10th of a turn) until the engine catches, and then plan to turn in back in as the engine warms up.
 - c. You can tell when the engine is at full operating temperature and ready for the setting of the final warm mixture when the engine thermostat opens causing the top tank of the radiator to get almost too hot to touch.
2. **Warm Engine:**
 - a. Check the lambda meter on the PCU panel. The correct mix will swing a bit around a reading of 1.00 (slightly richer than normal syngas operation).
 - b. If it reads over 1, turn the mixture knob out (counterclockwise) to richen the mixture one or two increments at a time, and pause for a few seconds to allow the new mixture to be read by the downstream O2 sensor. Continue with small incremental adjustments until the meter reads slightly less than 1.00.
 - c. If it reads less than .9 when started, turn the knob in (clockwise) in the same small steps until a reading between .9 and 1.0 is reached.



Note: Make a note of the mixture settings for your system for future operation.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.



Shut down:

Shut down the engine as normal, then remove the FI unit and unplug the fuel supply and close the vent in the fuel fill cap. The FI unit should clip onto the top or side of the tank. Store the system protected from the weather, heat and ignition sources and away from the PP.

WARNING: Always make sure the Purge System is unplugged from the Power Pallet and safely stored before starting on syngas.

Maintenance and Troubleshooting:

1. Red foam air filter should be cleaned with soap and water and then dried and re coated with light oil at least once a year or when it becomes dirty or clogged.
2. Gasoline has a shelf life of about 3 months. If you expect to store the tank with fuel for longer, we recommend adding a fuel stabilizer additive such as Stabil. Stale fuel will have an “off” smell, and may be hard to start and run roughly. Properly dispose of stale fuel and replace with fresh.
3. Pump should vibrate and fuel should flow as soon as starter is engaged or clip leads energized, if not, check the inline ATC blade fuse rated at 3A.
4. If pump vibrates and no bubbles are present in fuel line, but no fuel is coming out of the injector (you can remove the air filter to check) make sure the vent and the mixture needle valve are open. This may also be caused by a failed pump or clogged fuel filter.

The latest *Operation Manual* and *Technician's Handbook* for your mode lare available online at www.allpowerlabs.com/support

1010 Murray Street, Berkeley, CA 94710 USA • www.allpowerlabs.com

Tel: +1-510-845-1500 • Fax: +1-510-550-2837

Copyright 2016 ALL Power Labs, Inc. All Rights Reserved.