

HYDROGEN **ON THE GO!**

The Hydrogen Group

Installation & Operation Manual For 12V or 24V Engines



Attention

Only The Hydrogen Group factory-trained mechanics are qualified to install the Fuel Enhancement System. We insist that all work be performed by licensed mechanics who have been trained by The Hydrogen Group on installation procedures and how to mitigate potential hydrogen gas hazards.

Unqualified mechanics or untrained persons attempting to install Fuel Enhancement Systems are at risk of damaging the engine or vehicle on which the FES is installed and of creating serious hydrogen explosion hazards that may cause serious injury or death.

Please contact The Hydrogen Group to find a qualified shop closest to you for installation. Prices for installation are subject to change and set by the qualified shop.

WARNING:

NO SMOKING

SPARKS or OPEN FLAMES

Around the system cabinet

Hydrogen Safety Facts

Please Read these important hydrogen safety facts

1. Hydrogen burns hotter and faster than any other gas, about 10 times faster than gasoline.
2. A hydrogen flame is nearly invisible, and slightly blue.
3. Hydrogen is an odorless and colorless gas and is non-toxic.
4. Hydrogen burns / explodes very fast at concentrations as little as 4% hydrogen in air, and as high as 95% concentration.
5. Do not allow any ignition source such as a cigarette, electrical or grinding spark, or flame near the Fuel Enhancement System.
6. Platinum (such as platinum jewelry or a platinum sparkplug) is a powerful catalyst for hydrogen and will ignite hydrogen on contact, as if platinum was a flame. No spark or flame is required for platinum to ignite hydrogen instantly.
7. When as little as a cup of hydrogen is ignited, it creates a very loud bang or concussion that can permanently damage the hearing of nearby people.
8. Burning hydrogen creates H₂O (pure water) in the form of ultra-hot steam and plasma (flame).
9. Refer to a Hydrogen Material Safety Data Sheet (MSDS) for more safety information.

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Installation Summary

1. Locate a proper location to mount the FES (See page for examples
2. Build a bracket or frame to hold the unit securely in place (see page 10 for examples)
3. Mount the Bracket or frame to the previously identified location.
4. Mount the unit to the bracket or frame using bolts and rubber spacers if deemed necessary.
5. Using 6 or 8 gauge wire directly from the battery to the unit. It is recommended to install a 60 breaker on the positive wire.
6. Remove air intake prior to the turbo. Drill a hole and install the threaded bent pipe supplied with the unit. Pipe should be installed after the compressor line but prior to the turbo. It is recommended that it be installed as close to the turbo as possible.
7. Run a 3/8" fuel line from the unit to the bent pipe just installed. Make sure the line is secured firmly with zip ties or similar and not located in an area where it will be melted, pinched, or kinked.
8. Wearing rubber gloves and eye protection, mix one package 21oz.(600g) KOH chemical with 3 quarts of distilled water in a bucket. Pour the mixed solution in the reservoir. Tightly close the lid.
9. Start the engine. The FES should start to bubble within 30 seconds.

Normal Installation Toolkit and Supply List

Safety Equipment:

1. Goggles or full-face shield
2. Rubber gloves
3. Rubber apron
4. Steel toe boots

Parts:

1. The Hydrogen Group's Fuel Enhancement System
2. 6-8 gauge black and red wires with lug connectors, wire loom and ties
3. 60-amp breaker
4. 3/8-inch rubber fuel line hose, hose clamps and ties
6. L bracket for mounting FES
 - a. Plan for mounting to vehicle
7. Mounting bolts, rubber engine mounts
8. Hydrogen sensor
9. Distilled water
10. Package of KOH

Tools:

1. Plastic bucket, stir stick and funnel
2. Wrenches to match mounting bolts
3. Phillips screwdriver
4. Wire crimpers
5. Voltmeter, clamp meter
6. Drill and bits (for air intake manifold)
7. Sealant (for air intake manifold)

Introduction and Important information

Introduction:

The FES converts distilled water into hydrogen and oxygen gases that flow to a diesel engines air intake and into the cylinders. Hydrogen burns ten times faster than diesel. The result is a faster and more efficient ignition of diesel fuel with reduced fuel consumption, harmful emissions, and greenhouse gases.

Note that catalytic converters and Diesel Particulate Filters (DPF) burn or collect exhausted fuel after it leaves the engine cylinder, where no automotive benefit is gained. The Hydrogen Group's Fuel Enhancement System burns fuel more efficiently during the power stroke, so there is less unburned fuel going out the exhaust pipe. The Hydrogen Group's Fuel Enhancement System target market is large diesel trucks with engines in the range of 12 to 16 liters. The FES cost can typically be amortized usually in less than a year.

Important Information:

The Hydrogen Group's Fuel Enhancement System ("FES") is a vital component, integrated into the normal operation of a diesel engine. As such, the FES MUST be installed or removed by a fully qualified and licensed mechanic with expertise on the engine in question, and who has been trained by The Hydrogen Group in the installation and removal procedures. The use of unqualified or untrained technicians for the installation or removal of the FES could lead to damage to the engine and will void The Hydrogen Group or engine warranty.

Plan the mounting location

The FES requires a sturdy mounting to the truck. It must be out of the way of moving parts, hot exhaust components, and not exposed to colliding with objects passing near the truck. Provide adequate ground clearance. Provide enough room above the FES for refilling distilled water and system servicing. Also, leave enough room to open the front panel of the system.

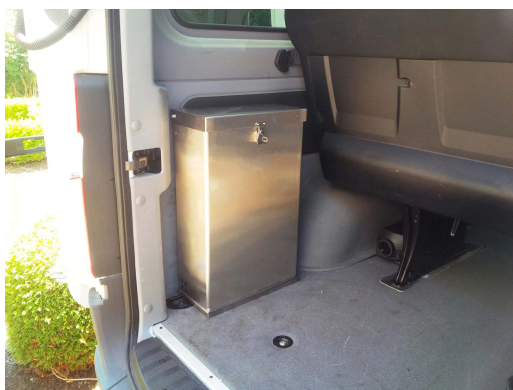
Plan the following:

- The routing for the 12- or 24-volt electrical power wires from the engine battery to the Fuel Enhancement System.
- the route for the rubber fuel line hydrogen hose from the FES to the engine air intake.

Note:

Make sure wires and hose can be routed safely away from any hot surfaces or where they can rub though or be kinked. Wires and hoses should be secured with zip ties or similar. Wires should be covered in wire wrap.

Examples of installations



Install Mounting Bracket or Frame

The FES requires a mounting bracket, suitable for the position and type of installation. Typically, an L shaped bracket is used to support the back and bottom of the FES. It should allow for convenient access and removal of the FES for servicing.

Trucks experience significant vibration and the FES is heavy. It may be necessary to protect the FES from vibration by using rubber engine mount cushions or cable springs. It is imperative that lock washers are used with all mounting nuts.

In all cases, it is important to be able to access the Fuel Enhancement System for servicing. The top must be accessible for adding water. The front must be accessible for cover removal and servicing.

Bracket Examples:



Warning: Do Not drill or weld to a tempered-steel truck chassis, as this may void the truck warranty and cause the truck chassis to structurally fail.

Install Electrical Wiring

The Fuel Enhancement System requires up to 40 Amps of electrical current from the engine alternator. There must be enough current capacity from the alternator to handle normal electrical loads plus the FES load, plus a reserve margin so the alternator does not overheat.

Ensure correct wire gauge for the wire-run between the battery and the Fuel Enhancement System

- #6 or #8 AWG (used for typical installations)

Note:

If too small of a wire gauge is used, the wire will overheat and may create a fire risk. Use only red-colored wire for the + 12 Volt circuit, and black-colored wire for the negative 12 Volt (also called vehicle ground) circuit. Do not use the truck's chassis as a ground conductor for the FES, as the current is too high. Insert the wires into plastic split loom as shown below.



Circuit Breaker

A 60 Amp circuit breaker (above) is required to protect the wiring from being overloaded. The circuit breaker is installed at the battery end of the positive wire. In the event of a short circuit event, the circuit breaker will shut off and protect the wiring and prevent a fire.

Important

Protect all wires from chafing, moving surfaces, and hot exhaust surfaces. Also, keep wires from interfering with vehicle mechanisms such as brakes, drive shaft, and engine controls. Wires must also be protected from road gravel and tire-tread debris.

Battery Connections

Check that each battery connection is attached to the proper battery post. Polarity is critically important to prevent destruction of the FES electronics. The black #6 AWG wire always connects to the negative post of the battery. See picture below. Verify this every time by looking at the battery markings.



1. Clean the truck's battery post if required.
 - Remove the battery cable clamps.
 - Clean post and clamps with battery cleaner as per directions of the battery cleaner
2. Run and cover the power cables to the Fuel Enhancement System.
3. Trim the ends of the red and black cables to the correct length. This is the very last stage of dressing the heavy red and black power cables.
4. Strip off ½ inch of insulation from each cable end, being careful not to damage the wire strands.
5. Crimp on the proper lugs. The lug wire size must match the wire gauge. Also, the lug hole size must be suitable for the machine screws securing them to the battery clamps.

Warning:

Vehicle battery external charging procedure

When charging the vehicle battery with an external charger, make sure to shut off the FES circuit breaker or disconnect the negative wire from the battery. Following this above procedure guarantees that the hydrogen system will not inadvertently produce hydrogen when the engine is not running.

Warning:

Hydrogen gas dissipation procedure

If a non-running engine was accidentally injected with hydrogen for more than a minute, it must be purged before the engine is started, otherwise an internal hydrogen explosion could damage the engine and possibly cause injury or death.

To purge the engine of hydrogen gas, first shut off the FES. Make sure that the vehicle is in a well-ventilated area where hydrogen gas cannot accumulate above. Remove the vehicle's engine air intake filter. Blow compressed clean air into one side of the air intake system for about one minute. Keep all dirt and small objects away from the air intake.

Hydrogen/ Oxygen Gas Hose Installation

1. Connect one end of the gas hose to the Fuel Enhancement System exit pipe and secure with a hose clamp. As a gas hose, we recommend the use of a standard 3/8" rubber fuel line hose.
2. The other end of the gas hose should be installed on the engine air intake manifold, in-between the air filter and the turbocharger, and as close to the turbocharger as possible.
3. Route the hydrogen gas hose from the Fuel Enhancement System to the engine air intake manifold and secure it. Keep the hose away from hot or moving surfaces. Ensure the hose is long enough to be properly secured with tie straps.
4. The installation kit includes a threaded bent steel pipe. Remove the air intake manifold and drill an appropriate size hole for the threaded portion of the pipe. Do not allow any drilling debris or parts to be sucked into the engine.
5. From inside the manifold, install the bent pipe with the L facing towards the turbocharger. Use a sealant to create an airtight seal around the threads. Use the outer nut to secure the bent pipe in place. Install the rubber fuel line hose and secure it with a hose clamp.
6. If removing the FES from any engine, make sure to plug the hole in the air intake manifold to prevent dust and dirt from being sucked into the cylinders.



KOH (Electrolyte) Mixing Instructions

The purpose of KOH is to make distilled water conduct electricity. The following instructions must be followed in the exact order listed below, for safety reasons.

Danger

Put water in the bucket first, and then add the KOH. Do not put the KOH powder in the bucket first, as this will create an exothermic reaction (the mixture will get very hot), create hydrogen gas and possibly explode.

Warning

Do not use tap water or any water except distilled water to make up the electrolyte. Distilled water contains no minerals. Minerals will damage the electrolytic cell plates.

Warning

Do not let KOH or electrolyte to come into contact with aluminum. Aluminum reacts with KOH to form hydrogen and will degrade the aluminum.

Mixing a new batch of electrolyte is only required for a new FES or every 3-6 months thereafter. The Hydrogen Group's FES is normally shipped with a package of KOH powder, sufficient for 1 gallon of water.

Electrolyte

Electrolyte is a liquid that conducts electricity. The Hydrogen Group's FES uses 10% (by weight) potassium hydroxide (KOH) in distilled water. The distilled water is consumed and should be replenished with every fuel fill. KOH is depleted slowly over a few months of FES operation.

Electrolyte Disposal

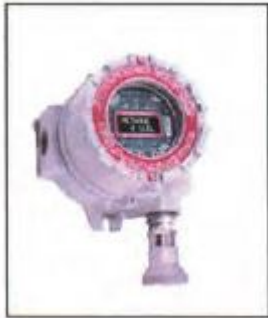
The Hydrogen Group's electrolyte is mildly caustic. Electrolyte that is to be disposed should be neutralized first. This can be done by mixing the electrolyte one-to-one with standard vinegar. Protective clothing and eye protection must be worn.

Electrolyte Mixing:

1. Set out items needed for mixing KOH and distilled water.
 - a. Safety full face mask
 - b. Rubber apron
 - c. Rubber gloves
 - d. An empty plastic bucket,
 - e. 1 gallon of distilled water
 - f. Plastic stir stick
 - g. 6" funnel
2. Wear all safety gear. KOH is caustic.
3. Measure 1 gallon of distilled water into the bucket
4. Slowly pour one pack of KOH powder into the distilled water while stirring. The KOH will dissolve quickly. The mixture will become very warm.
5. Using the funnel, pour the mixed water into the FES tank to the upper blue line. Stop filling when the red light on top of the circuit board box illuminates.

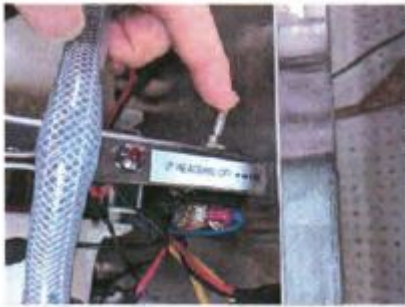
Installing a Hydrogen Sensor Alarm

When a Fuel Enhancement System is installed in an enclosed area such as a generator shed, it is important to protect the premises with a hydrogen sensor. Hydrogen is explosive in concentrations as low as 4.0 %. Install the hydrogen sensor at a location where the light hydrogen gas will accumulate. The sensor should be connected in series with the FES yellow enabler wire to immediately halt gas production.



Cold Weather Operation

The FES is fitted with internal heating elements to prevent the distilled water from freezing down to -22°F (-30°C). The Winter Switch must be flipped to ON any time the temperature is expected to fall below 32°F(0°C). Below -22°F(-30°C), the FES must be drained. Allowing the FES to freeze will damage the electrolysis cells. When the engine is running and the FES is operating, it generates sufficient heat to operate down to -22°F (-30°C). Below this temperature the FES must be drained. When the engine is not running and the FES is not operating, the internal heating elements are powered by the vehicle batteries. In normal situations, they will operate for 24 hours without significantly draining the batteries. If required for longer periods, the FES is supplied with an AC to DC transformer and connections to plug into a normal 110V - 220V AC power source.



System Testing

After The Hydrogen Group's Fuel Enhancement System installation is complete, perform the following steps:

1. Remove all installation tools and supplies from the vehicle.
2. Close the FES circuit breaker near the battery by rotating the yellow handle on the circuit breaker until it clicks.
3. Inspect the entire installation.
4. Start truck engine.
5. Make sure the light on the front of the unit is illuminated green.

You should see bubbles rising in the water reservoirs within a minute. If not, make sure the engine voltage is above 13.5 Volts, measured at the FES's electrical input terminals. If the FES is still not working, check your work for a wiring error. Call The Hydrogen Group for technical assistance if needed.

Shut off the truck's engine and note that the green light on the front of the FES shuts off and bubbles stop forming inside the FES.

It is crucial that the hydrogen stops flowing when the engine is shut off, otherwise an explosion hazard will exist.

Operator Information and Responsibilities

1. A Steady Green Light on the outside of the cabinet indicates that the Fuel Enhancement System is operating properly. This green light must turn off when the engine is shut off.
2. A Flashing Green Light indicates that the water level is low and must be replenished.
3. Fill tanks to a maximum of the upper line with DISTILLED WATER only. A Red Light will illuminate when the upper line is reached- Do Not Over Fill.
4. The Fuel Enhancement System internal dryer/blowback unit has an automatic drain valve that will open when the FES is not operating. This will drain a small amount of water onto the ground. The FES should be stopped at least once per 24 hours to allow this drain to open for a few seconds.
5. Ensure the Winter Switch is ON when the temperature goes below 32°F (0° C).
6. Drain the system completely below -22°F(-30°C).
7. To turn the unit off completely, press the red off button on the circuit breaker connected close to the engine battery. Rotate the yellow lever out of sight to turn the system back on or disconnect the negative wire at the battery. Do Not Turn Off Below -32°F (0°C) without draining the system or turning the heater on.

For more information, please contact The Hydrogen Group at:
Engineer Jeff Bradshaw 702-418-4771

<https://thehydrogen-group.com>