



# **HYDROGEN CONVERSION DIESEL TRACTOR**



## **Purpose**

**Convert Diesel Tractor to Operate on Hydrogen/Diesel Fuel Blend**

**Reduce Emissions**

**Reduce Dependence on Fossil Fuels**

## **Background**

**Wind To Hydrogen Project and Major Funding Sponsored by Basin Electric Power Cooperative**

**Three Trucks Have Been Converted to Hydrogen Fuel**

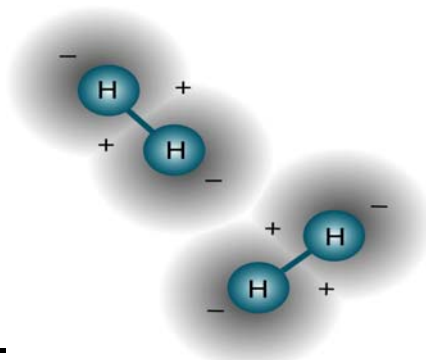
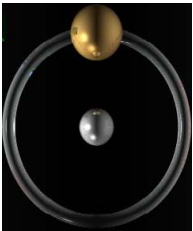
**Hydrogen Produced by Electrolysis Powered by Wind Turbine**

## **Collaborative Effort Of Conversion By**

**Mechanical Engineering**

**Agricultural And Biosystems Engineering**

**Electrical And Computer Engineering**



## **Tractor Specs**

**Challenger MT525B**

**95 PTO**

**Caterpillar 3056E Engine**

**5.98 Liter In-Line 6 Cylinder**

## **Hydrogen**

**Clean Burning**

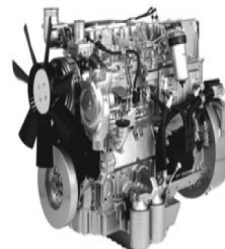
**3<sup>rd</sup> Most Abundant Element**

**High Energy Content/Unit Mass**

**Colorless, Odorless, And Tasteless**

**Low Density**

**Found in Nature**



## Hydrogen Plumbing Options

**Stainless Steel Tubing**

**Flexible Plastic Tubing**

**Hydrogen Will Not Permeate**

**Withstands High Pressure**

## Hydrogen Control

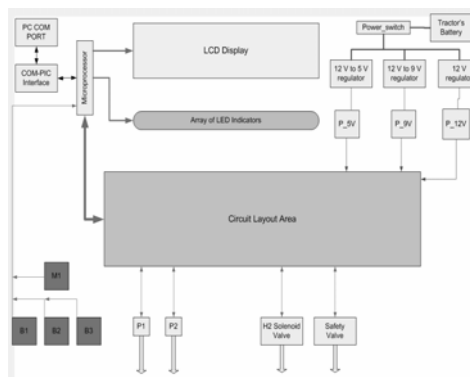
**Manual Needle Valve for Testing**

**Electronic Circuitry to Control  
Hydrogen Delivery System**

**Circuitry Will Control Valves and  
Monitor Pressures**



Needle Valve



Control Circuit Schematic

## Cylinder Pressure Sensing

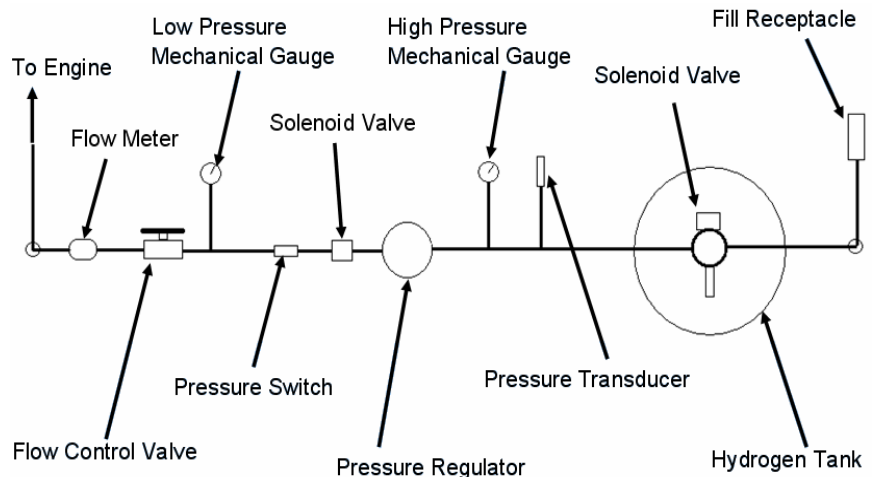
**Pressure Spikes When Hydrogen  
Combusts**

**Pressure Monitored Using Transducers  
Mounted in the Engine Head**

**Used to Set Hydrogen Flow Limit**

**Water Jacket Type Transducers**

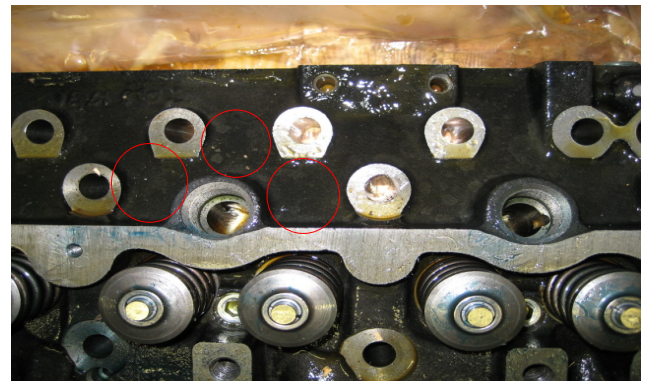
## Hydrogen Delivery System



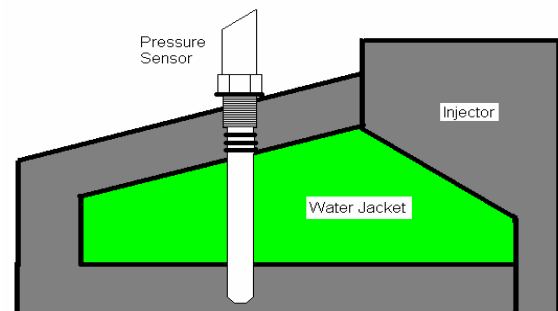
## Compressed Natural Gas (CNG) Components

**No Vehicle Standards For  
Hydrogen Components**

## Cylinder Pressure Locations



Engine Head With Possible Sensor Locations



Cylinder  
Side View Of Engine Head With Sensor Installed



# HYDROGEN CONVERSION TRACTOR MODIFICATIONS



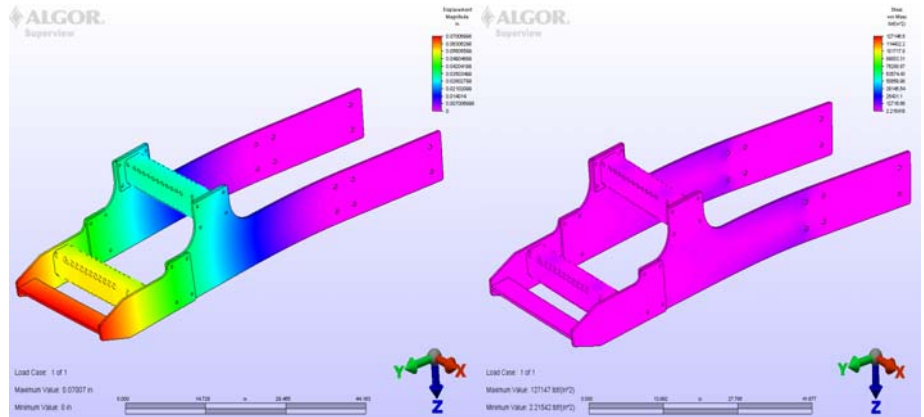
## Hydrogen Safety Precautions

Check Valves  
Pressure Switch  
Pressure Sensing  
Leak Tests  
Over-Pressure Shut-Off



## Tank Brackets

Displacement and Stress Analysis Performed  
Can Hold Two 140 lb Tanks Securely



Displacement FEA

Stress FEA

## Hydrogen Injection Methods

Multi-Cylinder vs. Single  
Injection

Aluminum, Fiberglass, Carbon Fiber

Front Tractor Location

Minimal Operator Sight Obstruction

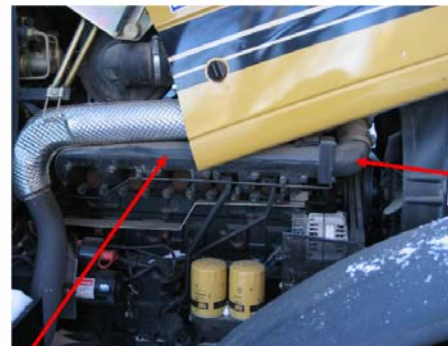
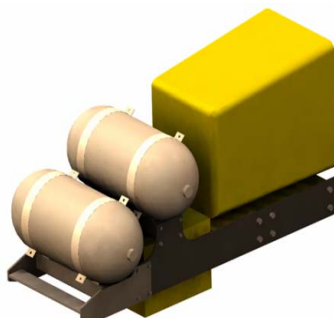
Short Hydrogen Delivery Line

Filling Ease and No Tractor  
Modification

Multi-Cylinder: Expensive, Engine Controller  
Obstacles

Single Injection: Simple, Less Expensive,  
Controlling Ease

Injection into Air Intake Elbow



Intake Manifold

Intake  
Elbow