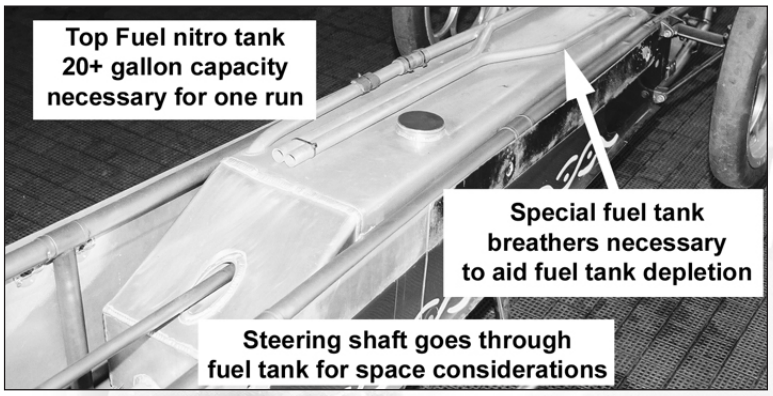
Why Mechanical Fuel Injection?

by Bob Szabo

Why mechanical fuel injection? Cause it's cool! And it's simple. From bracket racing classes to IHRA Top Fuel, mechanical fuel injection is the choice of many engine builders. In IHRA's Funny Car Class and supercharged competitors in Pro Modified, mechanical fuel injection has the demanding role of typically managing two gallons per minute of idle fuel volume and a fuel consumption rate equivalent to over 16 gallons per minute. With these race cars tuned for five to six-second performance, the one plus gallon of methanol consumed on a run provides the sound and sensational acceleration that IHRA fans and racers are now accustomed to. Another four to eight gallons are consumed in the remainder of the various run modes, including burnout and staging.



Top Fuel

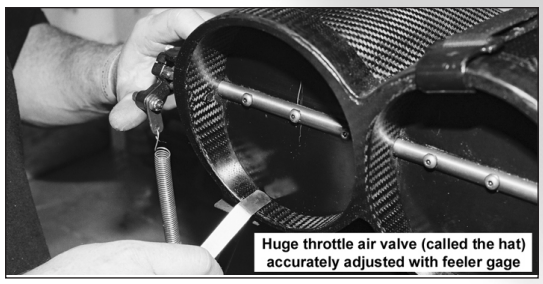
In the Top Fuel class, the fuel volumes are greater. Four gallons of nitromethane consumption is the typical idle fuel volume. Several gallons of nitro consumption are the norm for the run. Various photos are provided from around the pits of one of the popular IHRA Top Fuel teams, the Mohegan Sun. They illustrate some of the insider information about mechanical fuel injection.

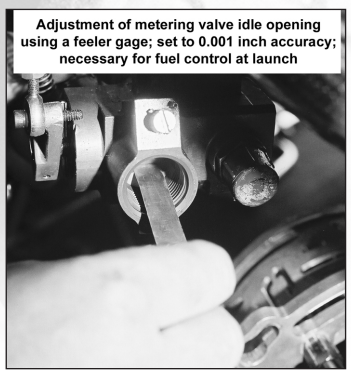
A typical fuel tank is shown in one photo. Fuel capacity of 20 gallons is a typical size. And a refueling of $20+ per gallon for nitro is necessary every run.

Notice the breathers on the top of the tank shown in one photo. Breathers allow air to fill the tank during nitro consumption. Breather placement is critical to provide undisturbed airflow. This is necessary for starting, the approach, burnout, return, staging, launch, and the run. Air must be allowed to enter, and fuel must be kept from leaking out during starting, the run, and stopping. Those requirements are met by important breather design and placement.

Tough on Fuel Injection

All of the modes of operation in a drag race put unique demands on fuel injection. The tuners will frequently adjust the throttle hat (shown in the figure) and the barrel or metering valve (the brain of fuel injection). The barrel or metering valve shown in the figure from the Mohegan Sun Top Fuel Dragster is a Pete Jackson valve. It is uniquely engineered for an instantaneous surge of fuel at the launch. In the photo, Grand Flowers, owner and crew chief, is carefully setting idle on the Pete Jackson valve with a feeler gage.





Gas or Alcohol Barrel Valve

Idle on gas or alcohol barrel valves is commonly set instead with a leak down meter and air pressure. This setup and the former method are quite different. A traditional gas or alcohol barrel valve can be adjusted for part throttle as well as full throttle fuel control. Due to the nature of the design, it is doubtful that a nitro fuel-metering valve could be adjusted for part throttle performance. Your street driven Top Fueler is likely to spin the tires every time between traffic lights.

Driveability

When you are in the pits at the next IHRA event, ask one of the Top Fuelers if you or your kid could drive their Top Fueler around the pits a bit to get the feel of it (in your dreams). If you do, you will probably find that part throttle operation is very poor.

Fuel Pump

In addition to the hat and barrel valve, a mechanical fuel pump is used to feed the fuel system. The 60+ gallons per minute fuel pump from the Mohegan Sun Racecar is shown in the photo. The mechanical fuel pump is normally driven from the engine. The volume of fuel is linearly related to engine speed. The faster the engine goes, the more the fuel volume increases.

High Speed Lean Out

Unfortunately, that fact, the differences in engine heat build up during a run, and engine efficiency all require unique fuel management. Most competitors lean out the engine at higher RPM using various hydraulic control devices.

In gas or alcohol, a spring-loaded poppet is common. As engine speed increases, the poppet opens. Fuel is then released back to the fuel supply. This leans out the engine. Tuners will read their spark plugs, rod bearing (for crush), or watch temperature data on their data recorders to determine the adjustments to the popper pressure and jetting of the bypass poppet.

The BDK Valve for Top Fuel

Nitro racers use a precision pressure relief valve (called dome loaded pressure relief valve or BDK valve). This device is regulated by fuel pressure or timers controlled air pressure. It is made by Don Jackson Engineering.

Tuning

A unique fuel curve is set up and tuned throughout the race. Experienced teams maintain extensive records of fuel curves from previous runs. They will search for the tuning condition such as track temperature, barometer, and other values from previous runs. Then when the best match is found, the fuel curve from that previous run is set up for the next run. It is often modified a bit: sooner or latter, more or less, for differences in the conditions. Examples would be new equipment or a better or worse track surface from before.

If all of this sounds extensive and demanding, it is. Tuning professional Top Fuelers is as difficult as launching a satellite in many respects. The level of difficulty on a "dollars per decision" basis is far more extensive for Top Fuel.

Other Fuel Injection Components

In addition to the hat or injection, barrel valve, fuel pump, and fuel tank are many other components to an IHRA mechanical fuel injection system.

Those fuel lines and shut off valves that can be seen on the racecars all provide necessary functions as fuel delivery and emergency shut off. More recently, fuel systems are now equipped with sensors to measure fuel flow and pressure. This information is stored on a recorder. Records are examined after the run to determine tuning decisions for the next run.

Mechanical fuel injection is the most obvious part of an engine that is so equipped. It is often the center of last minute tuning by the crew chiefs on the starting line. It modulates engine power on the launch from idle to full power in a fraction of a second.

Watch with curiosity and respect as the various IHRA racecars with fuel injection launch in a blink of an eye. Zero-to-60 times are usually less than one second regardless of the class. What a trip that would be on the highway with that kind of power and setup.

In reality, that kind of power belongs only on the racetrack with all of the necessary safety provisions such as side barriers. On occasion, you may see a drag race car launch into a barrier. Those kinds of acceleration levels from racing components such as mechanical fuel injection can really launch a vehicle. Usually straight out of the gate; but every so often a bit crooked. Yes we do need the approved racetrack.

About Bob

Bob Szabo is a race car book author. He just completed a new book "Fuel Injection Racing Secrets." This book is all about mechanical fuel injection for IHRA drag racing, and it is supplier recommended. Bob is a lifetime student of technology. He will join the IHRA spectators at up-coming events to enjoy the finest drag racing in the world. He will share many of his experiences in this and future issues of DRM. For book ordering information, look on the Internet at http://www.racecarbook.com or call (707) 446 2917.