Kinsler Fuel Injection, Inc.

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Engineering, manufacturing, sales, service, calibration, testing, and modification of mechanical and electronic fuel injection systems and components for all types of racing and performance.

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SELECTION OF A MECHANICAL FUEL PUMP TO SUPPLY AN EFI ENGINE

We are continually asked;
"Which displacement mechanical fuel pump do I need for my _____HP EFI engine" ?

When selecting a mechanical pump we need to consider the RPM at which the pump will operate and the specific target RPM for Peak Torque and Peak HP for the engine. Typically the mechanical pumps are operated at ½ crankshaft speed.
They can be driven faster or slower to alter the output provided the safe maximum speed is not exceeded. Over spinning a pump can lead to inlet cavitation causing erratic fuel delivery performance and damage to the fuel pump and or engine .

Due to the wide variation of engine efficiency and Air Fuel Ratio values, selecting a mechanical pump can be challenging.

Probably the simplest way to size the pump is to use the total injector flow capacity in cc/minute at the operating pressure. Then add more volume for maintaining bypass flow to maintain pressure through the fuel pressure regulator / relief bypass circuit.
NOTE: This method assumes the end user has selected the correct injectors required to properly meet the engine demands. If a minimal duty cycle is being utilized with the fuel injectors, this method could have significant excess volume.

Let us take a look at one example: If we have (12) injectors that are rated at 1050cc per injector @ 43.5 PSI and we intend to operate them at 90 PSI. We need to first calculate the flow per injector at 90 PSI. "Orifice Theory" as shown in the Kinsler Handbook/Catalog #32, tells us that the flow through the injector will increase as pressure increases by the square root of the pressure difference.
Therefore; 90 PSI divided by 43.5 PSI = 2.069 times the pressure.
The square root of 2.069 = 1.438. 1.438 is the ratio of the flow increase in this example.
So,…1.438 times 1050cc/inj = 1510 cc/min per injector at 90 PSI.
Now that we have our injector flow adjusted for pressure, we can multiply the quantity of injectors by the new adjusted flow rate.
(12 injectors times 1510cc/min = 18,120 cc/min total injector flow capacity.)

Next add the additional bypass volume to maintain pressure regulation.
We suggest a value of ~ 2000cc/min be added to the total flow.
For this example: 2,000cc + 18,120cc = 20,120cc/min at 90 PSI.

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A US gallon of fuel contains 3785cc, therefore 20,120 cc divided by 3,785cc = 5.316 GPM
We have determined we need a mechanical pump that will flow 5.316 GPM and must relate this to the pump shaft speed and engine RPM.
A Tough Pump can now be selected depending on the engine RPM at which max HP will be generated and at what ratio of engine speed the pump operates.
If peak HP is at 7000 engine RPM and the pump is driven at ½ crankshaft speed, then the Tough Pump 700 which flows 5.77GPM at 3500 pump shaft speed will be a good selection.

Selecting a pump based only on Horsepower requires either specific knowledge of the Engine's fuel efficiency, aka "Brake Specific Fuel Consumption" (BSFC) or performing calculations with theoretical assumptions for the efficiency values.
Brake Specific Fuel Consumption is the mass of fuel, typically reported in lb./hr., required to produce one corrected NET HP measured on the crankshaft.
Note: The popularity of the Chassis dynamometer has led to assumptions about driveline losses and gross flywheel power. It does not typically provide measured BSFC values like a properly instrumented engine dynamometer will provide.

Most gasoline naturally aspirated engines will have a BSFC value in the range of .45-.50. Some highly efficient engines will have slightly lower BSFC values, while less efficient engines will have higher BSFC values and require a bit more fuel per HP.

Most methanol naturally aspirated engines will have a BSFC value in the range of .90-1.2
Just like the gasoline engines, these values will vary with the actual engine's efficiency.

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Boosted engines require more fuel per HP to;
- **Provide a richer mixture**
- **Prevent pre-ignition and to cool the intake charge**
- **Provide fuel for added mechanical or pumping drag from the Supercharger.**

Engines equipped with mechanical driven superchargers will require more fuel per HP due to both the added mechanical friction required to drive the supercharger and also the additional fuel to aid in cooling the engine and prevent pre-ignition. We suggest adding a minimum of 15% when calculating for the approximate fuel for a belt or gear driven supercharged engine. This 15% could easily jump to 35% on a highly boosted engine. The higher percentage is especially required when no additional charge cooling is being utilized. (No Intercooler on a highly boosted engine).

Engines equipped with Turbochargers are more efficient as the turbine is driven via the exhaust gases and will not add as much to the parasitic losses associated with power production. The exhaust backpressure from the turbine may increase the engine pumping loss on the exhaust stroke and affect power production.

Feel free to contact a Kinsler Technical Assistant when selecting a fuel pump.