PART NUMBER: 20100 & 20150

**PETRON PLUS FORMULA 7**
**ULTRA ALL-SEASON DIESEL FUEL CONDITIONER with LUBRICITY**

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**PETRON PLUS™ FORMULA 7**
**ALL-SEASON DIESEL FUEL CONDITIONER with LUBRICITY**
Part No. 20100

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**INTRODUCTION**

Paraffinic hydrocarbons are present to a greater or lesser extent in all diesel fuels. Normal or so-called straight chain paraffins, which are abundant in many straight-run distillates, have particularly high cetane numbers, and are therefore important blending components. Unfortunately, the higher molecular weight members of the normal paraffin chemical family are waxy in nature, and tend to solidify at the temperatures experienced in many parts of the US during the winter season.

Without the addition of flow modifyers to the diesel fuel, these waxy components tend to crystallize into large flat platelets, which clump together and quickly lead to filter plugging, or even gelling of the bulk fuel. Either situation rapidly renders an engine inoperable.

To avoid such an undesirable occurrence, a refiner, fuel blender or truck fleet operator has a number of options available. The refiner can modify its processing scheme to eliminate the least desirable normal paraffins from the diesel blending streams, leading to a diesel fuel with a lower “natural” pour point and cloud point. In recent years this has happened to some degree as a by-product of government regulations requiring the sale of low sulfur (<0.05% wt.) diesel fuel for on-highway use.

The regional fuel blender has the option to take product obtained from a refiner, and lower its pour point either by blending with a low pour point kerosene, or by adding a small amount of a specialized additive, known typically as a pour point depressant, or a cold-flow improver. The amount of kerosene or cold-flow improver used for this purpose is quite dependent on both the properties of the diesel fuel being treated, and the lowest ambient temperatures expected in the region of use. A number of relatively straightforward laboratory tests can be used to assist the blender in making the blending decisions that have significant economic impact on his diesel business.

As an extra measure of precaution the truck fleet operator, for whom an inoperative truck is an economic disaster, can purchase quart to gallon size bottles of specially formulated cold-flow improvers at most truck stops. Such a container typically treats one or two tanks of fuel, and can be added to the system by the driver at any time when severe cold weather, or major temperature changes are expected. This latter approach offers great flexibility to the individual truck operators at a very modest cost compared to the cost of lost operating time. It is to meet this need that Petronomics Mfg. Group, Inc. has developed specialized formulations to improve diesel cold-flow properties.

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DISCUSSION OF PERFORMANCE FEATURES

The chemistry behind typical cold-flow improver formulations is designed to modify the wax crystallization process of normal paraffins that are present in diesel fuels. As a result, instead of the wax quickly forming large platelets which readily clog filters or cause the fuel to gel, it slowly forms micro crystals. These micro crystals are much less effective in plugging filters, and allow the fuel to flow at considerably lower temperatures than its "natural" pour point.

In modern diesel engine designs, a significant quantity of the fuel which is pumped from the fuel tank is not consumed immediately, but rather is re-circulated back to the fuel tank. In this process it is normally warmed significantly, and consequently serves to begin raising the temperature of all of the fuel in the tank. This quickly increases the fuel temperature above the danger zone.

Based on the above considerations, PMGI has developed an all-season diesel fuel performance additive concentrate, which can be used to formulate effective aftermarket products for sale to truck and fleet operators at truck stops or similar service centers. The latest version of this concentrate is identified as Petron Plus 20100, 20150 & 20175 as the aftermarket products. The specific ratio used depends on a number of factors. These include the recommended consumer treatment rate and the lowest expected ambient temperatures in the region, as well as the particular characteristics of the fuel being treated.

The critical low temperature performance enhancing features, which can be obtained with the use of Petron Plus 20100, are shown in the attached charts ASDFC-2 through ASDFC-4. In chart ASDFC-2, the untreated diesel fuel has a "natural" pour point as measured by ASTM D97 of -15°F. When an aftermarket version Petron Plus 20100 is added to the fuel at the rate of 8 ounces per 300 gallons, then the pour point is reduced to -30°F. This means that the safe operating ambient temperature for this fuel has been lowered by approximately 15°F. This is a very significant improvement. In similar ASTM D97 tests, when the treatment rate with the additive was increased to two and four times the above level, the pour point was lowered from -15°F to -32°F and -30°F respectively. Since all of these results are within the established reproducibility limit of the test, it can be concluded that for this particular diesel fuel the lowest pour point achievable by the use of conventional cold-flow improvement technology is in the region of -30°F. Further, this pour point depression is achievable at the very economical treatment rate of 8 ounces of additive to 300 gallons of fuel.

Since pour point depression characteristics are known to vary quite considerably with the composition of the diesel fuel, the best field performance is obtained by first testing the response of the actual fuel being treated. The fuel chosen for the above tests is widely used in the central US, where severe temperatures and drastic weather changes are frequent occurrences.

Although at one time the pour point of a fuel was considered most vital to its cold temperature operability, in recent years more attention has been focused on a fuel property known as the Cold
Filter Plug Point, (CFPP). The CFPP is deemed to give a more realistic measure of the actual temperature at which a fuel will operate under real world conditions.

Chart ASDFC-3 shows the relationship between pour point and CFPP for an untreated diesel fuel and for the same fuel when treated with two different levels of Petron Plus 20100, and ASDFC-4 shows the response of a third diesel fuel at several different levels of additive treatment.

The above data clearly demonstrates that actual performance of diesel flow improvers depends considerably on the composition and characteristics of the fuel being treated. While this makes recommending general treatment rate somewhat imprecise, our experience is that a treatment which provides about 300 PPM of active flow improver in the fuel will usually give very good results.

Another key performance requirement of diesel additives is the need to provide an added degree of protection against the type of abnormal fuel pump and injector wear, which has been noticed on occasion since the mandatory introduction of low sulfur highway diesel. Prior to this time, the sulfur containing impurities which occur naturally in diesel fuel blending stocks, acted as effective lubricity agents and prevented wear in the critical fuel system components. With diesel fuels containing less than 0.05% sulfur, especially those which have been blended with kerosene to improve winter time low temperature flow properties, the lubricity properties can be poor, and critical fuel system wear may occur.

Although the base diesel fuel evaluated by Petronomics Mfg. Group, Inc. in chart ASDFC-5 gave a wear scar in the acceptable range, the wear scar diameter was still reduced by 24% when the lubricity agent used in Petron Plus 20100 was added to the fuel. This indicates the high degree of protection available in the additive system.

While fuel system deposit formation is usually not as severe in the cooler winter months as in the height of the summer, there are advantages for a winter diesel additive package which contains at least a “keep clean” level of a detergent-inhibitor package. The detergent can be effective in dispersing any water that may condense in the system, and the inhibitor provides protection against possible corrosion. For this reason, Petron Plus 20100 has been formulated with a protective level of a powerful diesel detergent/inhibitor package.

**SUMMARY**

Drawing on many years of experience in formulating gasoline and diesel fuel additives, PMGI’s scientists have developed a cost-effective all-season diesel additive package. In order to provide a broad range of well-documented claims at the most attractive economies possible, PMGI has modified the latest available refinery technology specifically for aftermarket use. Petron Plus 20100 is registered for use in the aftermarket with the US EPA by PMGI.
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ALL-SEASON DIESEL PERFORMANCE ADDITIVE

PERFORMANCE FEATURES

• PROVIDES EXCELLENT LOW TEMPERATURE FUEL OPERABILITY

• SUBSTANTIALLY REDUCES COLD FILTER PLUG POINT (CFPP)

• REDUCES OR ELIMINATES THE USE OF COSTLY KEROSENE BLENDING

• CONTAINS AN EFFECTIVE LEVEL OF DETERGENT ADDITIVE

• IMPROVES FUEL ECONOMY

• HELPS REDUCE SMOKE AND PARTICULATE EMISSIONS

• HELPS REDUCE HYDROCARBON AND CARBON MONOXIDE EMISSIONS

• IMPROVES FUEL LUBRICITY FOR ADDED INJECTOR PUMP PROTECTION

• ENHANCES FUEL STABILITY DURING STORAGE

• HELPS PREVENT FUEL SYSTEM CORROSION
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ALL-SEASON DIESEL PERFORMANCE ADDITIVE

**POUR POINT REDUCTION: ASTM D97**

<table>
<thead>
<tr>
<th>FUEL TESTED</th>
<th>TREAT RATE</th>
<th>POUR POINT (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Fuel</td>
<td>0</td>
<td>-15</td>
</tr>
<tr>
<td>Base Fuel + PP-20100</td>
<td>8 oz/300 gallons</td>
<td>-30</td>
</tr>
<tr>
<td>Base Fuel + PP-20100</td>
<td>8 oz/150 gallons</td>
<td>-32</td>
</tr>
<tr>
<td>Base Fuel + PP-20100</td>
<td>8 oz/75 gallons</td>
<td>-30</td>
</tr>
</tbody>
</table>

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**Graph: Diesel Pour Point vs Additive Treat Rate**

- Gallons of Fuel Treated/Gallon of Additive
- Pour Point - Degrees F
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FOUR POINT AND CFPP COMPARISON:

![Diego fuel "A" additive response graph](image)

PP-ASDFC-3
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CFPP DATA:

DIESEL FUEL "B" ADDITIVE RESPONSE

Temperature Degrees F

Base Fuel + 200 ppm | + 300 ppm | + 500 ppm | + 1000 ppm

CFPP
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**LUBRICITY DATA: ASTM D5001**

The results shown below were obtained on the Ball-on-Cylinder-Lubricant-Evaluator (BOCLE) test with the lubricity agent used in Petron Plus 20100. The treatment rate was equivalent to 8 ounces of Petron Plus 20100 per 300 gallons of diesel fuel. The test was designed to measure the lubricity characteristics of low sulfur diesel fuels. Test conditions were 1 kg load at 25°C, and the results are reported as the Wear Scar Diameter (WSD), measured in millimeters.

<table>
<thead>
<tr>
<th>FUEL TESTED</th>
<th>WSD (mm)</th>
<th>% REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Fuel</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Base Fuel + Lubricity Agent</td>
<td>0.60</td>
<td>24%</td>
</tr>
</tbody>
</table>

**LUBRICITY TEST DATA**

![Graph showing lubricity test data](image)

PP-ASDFC-5