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# Biodiesel Fuel Specifications
## and Comparison to Diesel Fuel

Biodiesel is a legally registered fuel and fuel additive with the U.S. Environmental Protection Agency. Biodiesel fuel has chemical properties that are very similar to conventional diesel fuel, and does not require any engine modifications or new equipment to enable its use as a blend stock or substitute for conventional diesel.

Unlike conventional diesel fuel, biodiesel is a 100% renewable fuel, and significantly reduces levels of harmful pollutants and global warming gases. Biodiesel has also proved to be much more efficient than conventional diesel in its total lifecycle or 'well-to-wheels' total fossil fuel consumption. According to a recent study by the U.S. Department of Energy, when petroleum consumption for production, transportation and distribution is accounted for, "The energy yield of biodiesel is 280% greater than petroleum diesel fuel." Biodiesel can also make a meaningful contribution to national energy security by displacing up to 10% of current U.S. diesel consumption by 2020.

With these important benefits in mind, biodiesel distributors and users should also be aware of the specifications that govern biodiesel quality, and understand the differences in key performance parameters versus conventional diesel.

### Engine Performance

Biodiesel has a higher cetane number, which means that biodiesel fuel will ignite more easily in a diesel engine while also reducing engine noise. Biodiesel's higher cetane number offsets its lower BTU content, thus resulting in a negligible difference in overall fuel economy. With over 16 million miles of testing by various groups and agencies, it has been demonstrated that biodiesel usage produces a similar level of torque, horsepower and fuel economy as that achieved by using conventional diesel fuels.

Lubricity of diesel fuel depends on specific components in the fuel to prevent wear on contacting metal surfaces in critical engine parts such as the fuel injection pump or fuel injector. Low lubricity diesel fuel may cause high wear and scarring whereas high lubricity fuel may provide reduced wear and longer component life. Biodiesel fuel blends offer significantly higher lubricity than conventional diesel; a B2 biodiesel blend (conventional diesel with 2% biodiesel) can provide up to a 65% improvement in lubricity.

### Cold Weather Performance

Conventional diesel can start to cloud or even gel in cold weather. Biodiesel fuels have similar cold weather limitations but have higher cloud and pour points. However, these limitations are largely mitigated when using B20 biodiesel fuel. During sustained below-freezing temperatures, cold weather performance can be managed via the use of cold flow additives or using a winter grade diesel in the biodiesel blend. Please refer to our "Introduction to Biodiesel and Guidelines for Usage" for more information about using biodiesel.

### Biodiesel Specifications

The latest specification for B100 biodiesel fuel is ASTM D6751-07. ASTM is a standards group comprised of engine and fuel injection equipment manufacturers, fuel producers, and fuel users whose standards are recognized in the U.S. by governmental entities, including state agencies responsible for ensuring fuel quality. So called "biofuels" or "biodiesel fuels" that do not meet the ASTM standard outlined below are not legally biodiesel fuels and should not be used in diesel engines.

# Fuel Specifications

**Table 1. ASTM D6751 Biodiesel (B100) Specifications**

| | Test Method | Limits | Units |
|---|---|---|---|
| **Flash Point, Closed Cup** | ASTM D93 | 93 min | ° C |
| **Water and Sediment** | ASTM D2709 | 0.05 max | % volume |
| **Kinematic Viscosity @ 40° C** | ASTM D445 | 1.9 - 6.0 | mm2/s |
| **Sulfated Ash** | ASTM D874 | 0.02 max | % mass |
| **Sulfur** | | | |
| S 15 Grade | ASTM D5453 | 0.0015 max | % mass |
| S 500 Grade | ASTM D5453 | 0.05 max | % mass |
| **Copper Strip Corrosion** | ASTM D130 | No 3 max | |
| **Alcohol Content (One of the following must be met)** | | | |
| Methanol Content | EN 14110 | 0.20 max | % volume |
| Flash Point, Closed Cup | D93 | 130 min | ° C |
| **Cetane Number** | ASTM D613 | 47 min. | |
| **Cloud Point** | ASTM D2500 | Report to Customer | ° C |
| **Carbon Residue** | ASTM D4530 | 0.05 max | % mass |
| **Acid Number** | ASTM D664 | 0.50 max | mg KOH/g |
| **Free Glycerin** | ASTM D6584 | 0.02 | % mass |
| **Total Glycerin** | ASTM D6584 | 0.24 | % mass |
| **Phosphorus** | ASTM D4951 | 10 max | ppm |
| **Vacuum Distillation End Point** | ASTM D1160 | 360 ° C max | ° C |
| **Oxidative Stability** | EN 14112 | 3 min | hours |
| **Cold Soak Filtration** | Annex to D6751 | 360 max | seconds |
| **Calcium & Magnesium (combined)** | EN 14538 | 5 max | ppm |
| **Sodium & Postassium (combined)** | EN14538 | 5 max | ppm |

Table 1 provides detailed information about the ASTM D6751 specification for B100 biodiesel fuel.

Source: American Society for Testing and Materials, Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels, Designation D6751-07 (2007)

**Table 2. Selected Properties of Typical No. 2 Diesel and Biodiesel**

| Fuel Property | Diesel | Biodiesel | Units |
|---|---|---|---|
| **Fuel Standard** | ASTM D975 | ASTM D6751 | |
| **Lower Heating Value** | ~129,050 | ~118,170 | Btu/gal |
| **Kinematic Viscosity @ 40° C** | 1.3 - 4.1 | 1.9 - 6.0 | mm2/s |
| **Specific Gravity @ 60° C** | 0.85 | 0.88 | kg/l |
| **Density** | 7.079 | 7.328 | lb/gal |
| **Water and Sediment** | 0.05 max | 0.05 max | % volume |
| **Carbon** | 87 | 77 | wt. % |
| **Hydrogen** | 13 | 12 | wt. % |
| **Oxygen** | 0 | 11 | |
| **Sulfur** | 0.0015 | 0.0 to 0.0024 | wt. % |
| **Boiling Point** | 180 to 340 | 315 to 350 | ° C |
| **Flash Point** | 60 to 80 | 130 to 170 | ° C |
| **Cloud Point** | -15 to 5 | -3 to 12 | ° C |
| **Pour Point** | -35 to -15 | -15 to 10 | ° C |
| **Cetane Number** | 40 to 55 | 47 to 65 | |
| **Lubricity SLBOCLE** | 2,000 to 5,000 | >7,000 | grams |
| **Lubricity HFRR** | 300 to 600 | <300 | microns |

Table 2 compares certain key parameters for B100 biodiesel fuel versus conventional petroleum-based diesel fuel.

Source: U.S. Department of Energy, Biodiesel Handling and Use Guidelines (2nd Edition, March 2006)

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