Jenna Perry
448-4362

Temperature

Temperature causes changes in engine power because it affects both viscosity and density. An increase in fuel temperature will cause a decrease in viscosity, which will reduce power due to internal leakage in the fuel system, as described above. The maximum recommended fuel pump inlet temperature for Cummins® engines is 70°C [158°F].

An increase in fuel temperature will also cause a decrease in fuel density (increase in API gravity), which will reduce power due to lower energy content of the fuel. On Cummins® engines using the PT™, Quantum®, or HPI® fuel systems, the power loss due to increasing temperature is less than that on engines using the in-line, distributor, or CELECT™ systems (less than 1 percent per 5.5°C [10°F]), due to the inherent viscosity compensating characteristics of these systems.

Component Wear and Durability

This section shows the effects of contingency fuels on wear and durability of fuel systems components.

The use of contingency fuels can affect the wear and durability of both fuel pump and injector components within the fuel system. Many of these fuels are low in viscosity and lubricity, as measured in the Ball On Cylinder Lubricity Evaluator (BOCLE) or the High Frequency Reciprocating Rig (HFRR) tests. Fuels with low lubricity can cause failure of fuel system components. Other factors that affect wear and durability are sulfur, water, and sediment content. High sulfur content increases wear of the fuel system components. Abnormal quantities of water and sediment in the fuel will also cause excessive wear, as well as other engine problems.

Hot Restarts

This section shows how contingency fuels affect the ability of the engine to restart while still hot.

On Cummins® engines which use a distributor type fuel system, the use of contingency fuels can cause difficulty restarting the engine while it is still hot. In addition, if excessive wear exists in the fuel pump, the same difficulty can occur even when using fuels within the range listed in Required Diesel Fuel Specifications. The problem is caused by excessive leakage of fuel around the internal components of the fuel pump. Fuel leakage becomes excessive due to the high temperatures and low viscosity of the fuel. Excessive wear of the fuel pump components will make the problem worse. The leakage can become so great that the pump will not produce the fuel rate necessary to restart the engine. If this problem is encountered, it can be corrected by using fuel which meets the specifications in the Required Diesel Fuel Specifications section of this bulletin. If this does not correct the problem, repair or replacement of worn fuel pump components is necessary.

Alternate or contingency fuels can cause difficulty restarting a hot engine. The hot restart complaint can be caused by fuel burning prematurely during the first compression stroke. Lighter alternate or contingency fuels can enter the cylinder through an open injector caused by the thermal expansion that occurs during the heat soak after engine shutdown. The burning fuels increase the starting cylinder pressure and increase the amount of torque needed to start the engine. Lighter alternate or contingency fuels with lower flash points increase the probability of fuel entering and burning in the cylinder. This issue can, on occasion, occur when using fuels that meet the specifications listed in Table 1: Cummins Inc. Required Diesel Fuel Specifications. Various Hot Restart kits (sometimes referred to as a Hot Start Knock Kits) have been released by Cummins Inc. to address this issue.

If this complaint is encountered, it can be corrected by using fuels which meet the requirements in Table 1 of this bulletin.

Fuel Blending

This section presents the effects of blending fuels with used and new lube oil, other fuels, and with gasoline, gasohol, or alcohol. Biodiesel fuel blends are discussed in a separate section of this service bulletin.

There are two different types of fuel blending processes referred to in this section. The first is the blending of used engine lubricating oil to reduce fuel costs and to aid in disposing of used engine oil. This section also discusses the blending of fuel and engine oil in on-highway applications. The second is the blending of heavier fuels with lighter fuels to lower the wax content, cloud point, and pour point, and thus improve cold weather operation. In addition, the effects and hazards of mixing alcohol with diesel fuel are discussed.

Blending Fuel and Lubricating Oil for On-Highway Applications

WARNING

Some state and federal agencies have determined that used engine oil can be carcinogenic and can cause reproductive toxicity. Avoid inhalation of vapors, ingestion, and prolonged contact with used engine oil. If not reused, dispose of in accordance with local environmental regulations.

CAUTION

Never blend more than 5 percent used lubricating oil with the fuel. Do not blend other used oils with fuel, such as transmission fluid, gear case oil, and so forth. Additional oil blending restrictions are outlined in this section.

Used engine lubricating oil can be blended with fuel using the Cummins® Lube Oil Blender, Part Number 3376317 (110 volt, 60 Hz) or Part Number 3376362 (220 volt, 50 Hz). This process can be used to supplement the fuel supply as well as provide a means of disposing of used lubricating oil.

To blend used engine oil with fuel, follow the instructions provided with the Cummins® Lube Oil Blender.

CAUTION

Blending fuel with lubricating oil is not allowed for Cummins® Midrange and Heavy Duty engines equipped with exhaust aftertreatment. Oil blending on these engines will result in engine damage.

Two rulings by the United States Environmental Protection Agency (EPA) affect the practice of blending lubricating oil with diesel fuel in the United States. First, on September 10, 1992, the Office of Solid Waste of the United States Environmental Protection Agency determined that used lubricating oil was not classified as hazardous waste. In

addition, the blending of used lubricating oil with diesel fuel for burning in diesel powered vehicles was determined to be an acceptable method for disposing of used lubricating oil (57 Federal Register, R 41583, September 10, 1992). Second, beginning October 1, 1993, diesel fuel used in motor vehicles, as defined by the EPA, in on-highway applications must contain less than 0.055 percent sulfur by weight (Mandated in Section 211 of the 1990 Clean Air Amendments; 57 Federal Register, P. 19535, May 7,1992). Fuel blended with lubricating oil must also meet this specification.

Cummins Inc. provides the following guidelines for blending lubricating oil with fuel:

Engines required to use ultra-low sulfur diesel fuel (15 ppm sulfur maximum) are not allowed to blend used lubricating oil with diesel.
Midrange and Heavy Duty engines (displacements up to 18L) are not allowed to blend used lubricating oil with diesel fuel if the engine is equipped with an exhaust aftertreatment device, such as an oxidation catalyst, diesel particulate filter, or SCR system.
High Horsepower engines (displacements of 18L or larger) equipped with high pressure common rail fuel systems are allowed to blend used lubricating oil with diesel fuel up to a maximum volume-concentration of 0.5 percent using the Centinel™ system, regardless of the presence of an exhaust aftertreatment system.
All other Cummins® engines which do not fall in to the above categories are allowed to blend used lubricating oil with diesel fuel up to a maximum volume-concentration of 5 percent.
The blending of new lubricating oil to raise viscosity is also permissible, and is subject to the same restrictions previously mentioned. This helps to increase the viscosity of lighter fuels to acceptable levels. However, if the blended fuel used in motor vehicles for on-highway applications (as defined by EPA) exceeds the maximum sulfur content, United States federal law has been violated and penalties can be assessed. To be sure that blended fuel complies with the law, the following procedure must be followed. Both the diesel fuel and lubricating oil must have their sulfur content measured by a qualified laboratory using the testing method specified in ASTM D2622 (American Society of Testing and Materials Standard, or ISO 4260). Once the correct blend factor has been determined, multiply this by the volume of fuel to be blended. The result is the amount of this oil that can be blended with this fuel and remain within legal limits. Similar restrictions and processes must be followed worldwide where regional or national regulations can impose such sulfur limits.

As an example, consider 50,000 gallons of fuel with a sulfur content of 0.04 percent by weight and lubricating oil with a sulfur content of 0.5 percent by weight. Of this oil, 450 gallons can be blended with 50,000 gallons of this fuel and remain within legal limits for sulfur content in the United States. Margins must be allowed for measurement errors.

Blending Fuel with Fuel

Cummins Inc. recommends the use of a premium diesel fuel during winter (ambient conditions at -7°C [20°F] or below) operating conditions. Blended fuel must meet the specifications in Table 1: Cummins Inc. Required Diesel Fuel Specifications. See Additives section in this service bulletin.

In cold-weather operation, the most common method of preventing fuel waxing problems is to dilute heavier, higher wax content fuels such as diesel number 2 (D2) with lighter, lower wax content fuels such as diesel number 1 (D1) or jet fuel. This reduces the concentration of wax and thereby reduces both the cloud point and pour point. Blended fuels of this nature are more expensive to use both because they cost more and because they have a lower thermal energy content. A typical blended fuel contains 30 to 60 volume-percent light distillate fuel, usually

yielding a 3 to 7°C [5.4 to 12.6°F] drop in cloud point, and a 5 to 11°C [9 to 20°F] drop in pour point. Lower wax content fuels must be added BEFORE wax forms to be effective.

Blending Fuel with Gasoline, Gasohol, and Alcohol

WARNING

Do not mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.
WARNING

Under no circumstances must gasoline or alcohol be used to dilute diesel fuel. This practice creates an extreme fire hazard and under certain circumstances an explosive hazard. Gasoline dilution is not an effective way to lower cloud point (20 volume-percent gasoline only lowers cloud point 4°C [7°F] and it lowers the fuel viscosity, cetane number, and flash-point). Alcohol dilution will increase the cloud point.

Alcohol is considered a renewable energy source. Some suppliers integrate up to 15 percent alcohol in diesel fuel to form oxy-diesel or e-diesel. While the use of special additives addresses some of the problems with alcohol blending in diesel fuel, Cummins Inc. recommends against the use of such blends due to safety reasons. This kind of fuel is considered experimental and is not covered by warranty. Engine damage, service issues or performance problems that occur due to the use of these products are not considered a defect in workmanship or material as supplied by Cummins Inc. and can not be compensated under the Cummins Inc. warranty.

Additives

This section gives information on the use of fuel additives in Cummins® engines, including water emulsifiers.

Cummins Inc. neither approves nor disapproves of the use of any fuel additive, fuel extender, fuel system modification, or the use of any device not manufactured or sold by Cummins Inc. or its subsidiaries. Engine damage, service issues, or performance problems that occur due to the use of these products are not considered a defect in workmanship or material as supplied by Cummins Inc. and can not be compensated under the Cummins Inc. warranty.

Fuel Additives

Cummins® engines are designed, developed, rated, and built to operate on commercially available diesel fuel as listed in Table 1: Cummins Inc. Required Diesel Fuel Specifications; therefore, it is not our policy to recommend fuel additives.

In certain situations, when available fuels are of poor quality or problems exist which are peculiar to certain operations, additives can be used. However, Cummins Inc. recommends consultation with the fuel supplier or Cummins Inc. Service Engineering Department prior to the use of fuel additives.