- Be sure that fuel tanks are completely empty before transitioning from LSD to ULSD, and consider tank cleaning.
- It takes only a small amount of LSD blended with ULSD to bring the fuel sulfur content above 15 ppm.
- Consider using a stability additive for fuel in bulk storage.
- ULSD is more prone to oxidation than LSD. Consult your fuel supplier to determine if an additive is needed to maintain fuel quality in storage tanks.
- Closely monitor the fuel system for leaks, especially when first transitioning to ULSD, and correct them immediately.
- ULSD reacts differently than LSD with certain seal and gasket compounds commonly found in fuel systems, which means that leaks are more likely to occur, especially in older engines which were designed to run on LSD.

Fuel Dyes

It is common in many regions for fuel to be dyed, most often to identify its tax status. The fuel is most commonly dyed red, but other colors are used as well. Diesel fuel dye does **not** affect the chemical composition of the fuel and is sometimes used to distinguish it from fuels of differing grades, specifications, sulfur content, etc. Consult the fuel supplier to understand the significance of any dyes used in the fuel purchased.

Dyed diesel fuel may be used in Cummins® engines, provided the fuel meets all applicable regional, national, and international regulations for the engine application. The fuel **must** also meet or exceed the specifications outlined in Table 1: Cummins Inc. Required Diesel Fuel Specifications in this bulletin.

Fuel Cleanliness

This section explains the importance of fuel cleanliness to the successful operation of Cummins® Engines.

Modern fuel systems have been developed to reduce emissions and fuel consumption, and improve engine performance. These high pressure systems operate at pressures approaching 2100 bar [30,500 psi] and with component match clearances typically from 2 to 5 microns for injectors. At these pressures, very small, hard particles are potential sources of fuel system malfunction.

Excessive contamination of diesel fuel can cause premature clogging of diesel fuel filters and/or premature wear of critical fuel injection system parts. Depending on the size and nature of the particles, this can lead to:

- Reduced component life
- Component malfunction
- Fuel system and/or engine failure.

Determining fuel cleanliness requires measuring both the size and number of particles per size class in the fuel, i.e. the particle size distribution. The International Standards Organization (ISO) has developed a protocol for expressing the level of contamination by

coding the size distribution called ISO 4406.

ISO 4406 cleanliness codes are expressed as a series of three numbers (#/#/#), which correspond respectively to the number of particles greater than 4, 6, and 14 microns. For example, the numbers in the ISO 4406 rating of 18/16/13 translate to:

18 - Up to 2,500 particles larger than 4µm (per mL of fuel)
16 - Up to 640 particles larger than 6µm (per mL of fuel)
13 - Up to 80 particles larger than 14µm (per mL of fuel)

Engine builders and fuel injection equipment manufacturers have found that the particles greater than 4 microns and greater than 6 microns are particularly critical to the durability of the fuel injection system. They also recognize that the fuel systems **must** tolerate hard particles smaller than 4 microns that are difficult to filter out, even with the finest filtration. To maximize the efficiency and effectiveness of filtration, Cummins Inc. has adopted the recommendation of the World Wide Fuel Charter that fuel supplied to engines meet the ISO 4406 code of 18/16/13 maximum for respectively 4, 6, and 14 micron particle sizes.

Cummins Inc. recommends that if the fuel does **not** meet the ISO cleanliness code of 18/16/13 when supplied to the engine, additional filtration be applied before the fuel is delivered to the equipment's fuel tank. A Cummins® Distributor or Cummins Filtration™ representative can supply hardware and additional filtration guidance and can recommend countermeasures such as improved fuel quality from the fuel supplier, and/or better fuel handling, storage, dispensing, and fuel tank cleaning techniques.

Tank Vent Filtration

Particles in the 4 to 6 micron size range require laboratory equipment to identify, yet can do significant damage to high pressure fuel systems when the cleanliness of the fuel in the tank exceeds the ISO 4406 code 18/16/13 maximum. Cummins Inc. recommends that all fuel tanks be fitted with a tank vent filter (of at least 98.7 percent efficiency at 10 micron) to prevent dirt from entering the tank as the fuel level drops.

Stand-by and Emergency Power Generation

Engines intended to supply stand-by or emergency power present unique situations for fuel quality and cleanliness. These engines are **not** used frequently, and therefore could possibly require special considerations for fuel handling and storage.

The engine manual discusses the specific procedures for maintaining the engine in a state of readiness. This section is concerned with the fuel supply.

Fuel tanks **must** be inspected and maintained to avoid contamination of the fuel by either water or dirt. Consult with your fuel supplier for qualified persons or laboratories in your area to help with monitoring of the fuel supply. Samples can be taken from the top, middle, and bottom of the tank every 6 months and checked for cleanliness and biological contamination, as well as to make sure the fuel still meets the specifications in Table 1: Cummins Inc. Required Diesel Fuel Specifications in this service bulletin.

Long term storage (in excess of 6 months) is **not** recommended unless the fuel has been stabilized by the fuel supplier and there is a monitoring program in place. Periodic testing of the engine is recommended to be performed frequently enough and long enough to make sure that the fuel supply is replenished and stays fresh.