Cenex® Winter Fuels Products & Best Practices for Handling

CENEX®

WINTERMASTER®
Winterized Premium Diesel Fuel

ROADMASTER XL®
SEASONALLY ENHANCED HIGHWAY PREMIUM DIESEL FUEL

RUBY FIELDMASTER®
SEASONALLY ENHANCED OFF-ROAD PREMIUM DIESEL FUEL

Table of Contents / Best Practices

Learn more about these topics in this guide:

Best Practices for Handling Diesel Fuel in Winter Weather

Proper tank maintenance and fuel handling helps ensure your fuel supply stays clean and fresh in your storage tank — and remains that way until it reaches your fuel system. By following the tips and information in this guide, you can avoid most common cold-weather problems, and ensure reliable travels through the most challenging season of the year.

Be mindful of these key issues before cold weather strikes, and keep your customers informed, too:

- The true measure of your diesel fuel's cold weather performance is measured by operability, cloud point (CP), cold filter plugging point (CFPP) and the cetane number.
- Ultra Low Sulfur Diesel Fuel has different cold flow characteristics than Low Sulfur Diesel Fuel (LSD.)
- There is a proper way to blend diesel fuels, biofuels and fuel additives.
- Proper tank maintenance and fuel filtration is a critical step to insure your customer's fuel operates at optimal levels.
  Fuel handling and tank maintenance must be done properly. You can avoid most common cold weather problems, and ensure reliable performance year-round.
- Proper use of cold flow improvers can extend operability of fuels by:
  Changing the diesel fuel wax structure utilizing wax dispersants.
  Dispersing wax, thus keeping wax crystals from congregating in the fuel.
- In order to understand fuel performance issues, a complete analysis of the fuel inside a storage tank is required, following the correct sequence and having the proper fuel sampling equipment is crucial.
- In the event of a winter fuels failure, it is essential to get as much information as possible by asking the proper questions and taking fuel samples for analysis.

Better Diesel Fuel for a Business That Demands Efficiency

Only Cenex® Winterized Premium Diesel Fuels deliver superior cold weather operability while optimizing power and engine performance. Unlike typical winterized diesel fuels, they contain an advanced performance additive package that allows for extreme-low-temperature operability. So you can count on Cenex Winterized Premium Diesel Fuels inside your fleet even when it's bitter cold outside.

Cenex Winterized Premium Diesel Fuels optimize performance with a complete, high-quality, multifunctional additive package that:

- Has a cold-weather operability of -30°F*
- Improves fuel economy by as much as 5%
- Improves power up to 5%**
- Has a typical cetane number of 48**
- Lowers maintenance costs
- Extends life of injectors / injector pumps

Cenex knows you need to keep vehicles at their peak performance and your operation profitable. Cenex Winterized Premium Diesel Fuels are the fuels to help you do it.

Above claims are in comparison to an untreated #2 diesel fuel
* Cenex Wintermaster® blend only
** #1 ultra low sulfur diesel (ULSD) offers less power than #2 ULSD due to lower BTU content

Cenex® Winterized Premium Diesel Fuels

Cenex Winterized Premium Diesel Fuels

CENEX WINTERMASTER
Winterized Premium Diesel Fuel

Cenex Wintermaster® Premium Diesel is formulated with an operability of -30°F and a cold filter plugging point (CFPP) of -55°F. Cenex Wintermaster is specifically formulated for the demands of diesel powered equipment in the most extreme winter conditions.

CENEX ROADMASTER XL
REASONALLY ENHANCED HIGHWAY PREMIUM DIESEL FUEL

CENEX RUBY FIELDMASTER
REASONALLY ENHANCED OFF-ROAD PREMIUM DIESEL FUEL

NEW: Cenex Roadmaster XL® and Ruby Fieldmaster® Seasonally Enhanced Premium Diesel Fuels are formulated for moderate climates and provide outstanding shoulder season flexibility. Cenex Seasonally Enhanced Premium Diesel Fuels deliver a cold filter plugging point (CFPP) of -25°F.

NEW: #1 Diesel Fuel with Cenex Premium Diesel Fuel Additive is used to blend down your Cenex Premium Diesel Fuel tanks during transition from summer to fall / winter, helping ensure additives remain at proper levels. Ideal for blending down bulk tanks, retail fueling site tanks and customer storage tanks.

And like all Cenex Premium Diesel Fuels, our new winter line up meets the requirements for Cenex® TPP™ Warranty coverage in agricultural equipment.

Cenex® Winterized Premium Diesel Fuels Comparison Chart

ATTRIBUTES / BENEFITS	Cenex Wintermaster®	Cenex RMXL® SE* Cenex RFM® SE†	#1 Diesel with CPDA‡
CFPP	-55°	-25°	**
Operability °F	-30°	**	**
Optimizes performance in all diesel engines	√	√	√
Improves fuel economy by as much as 5%	√	√	
Increases fuel lubricity by 10-15%	√	√	√
Improves power by up to 4.5%	√	√	
Typical Cetane Number	48	48	43
Extends life of injectors / Injector pumps	√	√	√
Reduces downtime and maintenance costs	√	√	√
Performs better than standard diesel fuels in modern diesel engines	√	√	√

ADDITIVE PACKAGE COMPONENTS	Cenex Wintermaster®	Cenex RMXL® SE* Cenex RFM® SE†	#1 Diesel with CPDA‡
Injection Stabilizer	√	√	√
Lubricity Improver	√	√	√
Demulsifiers	√	√	√
Storage Stabilizers	√	√	√
Corrosion Inhibitors	√	√	√
Detergents	√	√	√
Cetane Improver	√	√	√

* **Cenex RMXL® SE** — Cenex Roadmaster XL® Seasonally Enhanced Premium Diesel Fuel

**Contact your authorized Cenex Premium Diesel Distributor.

† **Cenex RFM® SE** — Cenex Ruby Fieldmaster® Seasonally Enhanced Premium Diesel Fuel

‡ **CPDA** — Cenex Premium Diesel Additive package

How Cenex® Premium Diesel Fuels Work

Not all "winterized" diesel fuels are the same. No other diesel fuel contains a more complete, high-quality, multifunctional additive package than Cenex Winterized Premium Diesel Fuels. It's all done to ensure you get the performance you expect from the vehicles you depend on.

Feature: Wax Crystal Modifiers

+ Significantly increases cold weather operability
+ Reduces downtime

Feature: De-icers

+ Reduces moisture-related problems

Feature: Wax Anti-settling Agents

+ Increases cold weather operability
+ Reduces downtime
+ Reduces maintenance costs

Feature: High Cetane

+ Reduces strain on engines and electrical systems
+ Promotes longer engine life, less maintenance and reduced downtime

Feature: Aggressive Detergents

+ Improves fuel efficiency
+ Maximizes horsepower
+ Extends life of fuel pumps and injectors

Feature: Lubricity Components

+ Reduces downtime and repair costs
+ Extends life of the fuel pump

Feature: Demulsifiers

+ Permits easy removal of water from storage tank
+ Decreases wear to injectors
+ Requires fewer fuel filter replacements

Feature: Corrosion Inhibitors

+ Saves the cost of rebuilding injection pumps
+ Extends pump life
+ Reduces downtime and repair costs

Feature: Injection Stabilizers

+ Addresses fuel oxidation problems in new engine technology fuel injectors
+ Prevents injector fouling in engines with tight tolerances
+ Reduces the frequency of filter and injector replacements

Feature: Stabilizers

+ Fewer fuel filter replacements
+ Prevents algae formation
+ Reduces varnish and gum build-up
+ Antioxidants extend the life of diesel fuel
+ Allows for 3 to 6 months longer storage

WINTERMASTER Winterized Premium Diesel Fuel

ROADMASTER XL SEASONALLY ENHANCED HIGHWAY PREMIUM DIESEL FUEL

RUBY FIELDMASTER SEASONALLY ENHANCED OFF-ROAD PREMIUM DIESEL FUEL

Cloud Point and Operability

The cloud point is the temperature at which paraffin, which is naturally present in #2 diesel fuel, begins to form cloudy wax crystals. When the fuel temperature reaches the cloud point, these wax crystals flow with the fuel, and coat the filter element. This quickly reduces the fuel flow, starving the engine.

Operability — equipment still functioning (filters not plugged).

Q. ***How can you tell if fuel has reached its cloud point?***

A. The fuel looks cloudy.

Fuel Cloud Point

Fuel and cloud point

Fuel at cold filter plugging point

The Cold Filter Plugging Point (CFPP)

The Cold Filter Plugging Point (CFPP) is the temperature when fuel will plug filters.

#1 or Y grade fuel — Typically has a cloud point and CFPP of -40°F or lower

- #1 made in the southern tier refineries typically has a cloud point of around -40°F
- #1 made in the northern tier refineries typically has a cloud point of around -60°F

#2 or X grade fuel — Pipeline terminal specification for cloud point is typically around 14°F

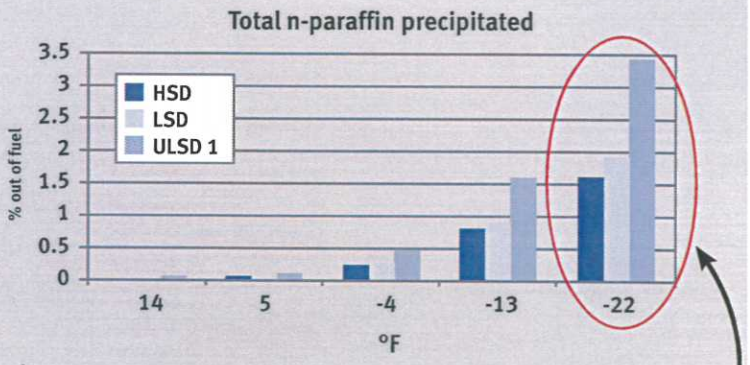
- #2 made in southern tier refineries typically has a cloud point of around 14°F
- #2 made in northern tier refineries typically has a cloud point of around 6°F

Biodiesel — Biodiesel blends may have a negative impact on the cloud point of fuel

- B2 and B5 impact is typically minimal, 2-3°F
- B10 blends and higher may have a significant impact, 10° or more

Ultra Low Sulfur Diesel Fuel (ULSD)

Ultra Low Sulfur Diesel Fuel (ULSD) —
The structure of wax in ULSD is different than low sulfur diesel fuels.



The difference in wax structure leads to more wax dropping out more quickly. This is why ULSD is more difficult to treat with cold flow improvers and why some ULSD #1 doesn't reduce the cloud point of ULSD #2 fuels as readily.

Proper Blending

A primary cause of winter fuel-related problems is tanks that are not properly "blended down", meaning fuel has a higher operability than intended. Blending down a tank is done by adding #1 diesel fuel to #2 diesel fuel. This helps maintain cold weather flow characteristics, increasing the operability of fuel.

When blending down a tank, pay close attention to the amount of fuel in the tank, know your proper treat rate, and be sure to calculate it accurately. Treat rates vary by region or climate; for more information, contact your Cenex Representative.

Example:

A 2,000 gallon tank has 700 gallons of fuel remaining. The proper treat rate for the region is a 50% #1 and 50% #2 blend.

Q. *How much #1 would you bring to the tank to create a 50-50 blend?*

A. 700 gallons.

Typically, a primary reason for winter fuel related problems is that tanks are not properly blended down. A common mistake, using the example above, is to bring in 700 gallons of a 50-50 blend and add it to the existing #2 fuel. That would result in a blend of 1,050 gallons of #2 and 350 gallons of #1 or roughly a 71% #2 and 29% #1 blend.

Rule of Thumb:

Adding 10% #1 will reduce the cloud point of #2 fuel by 3 degrees.

Example:

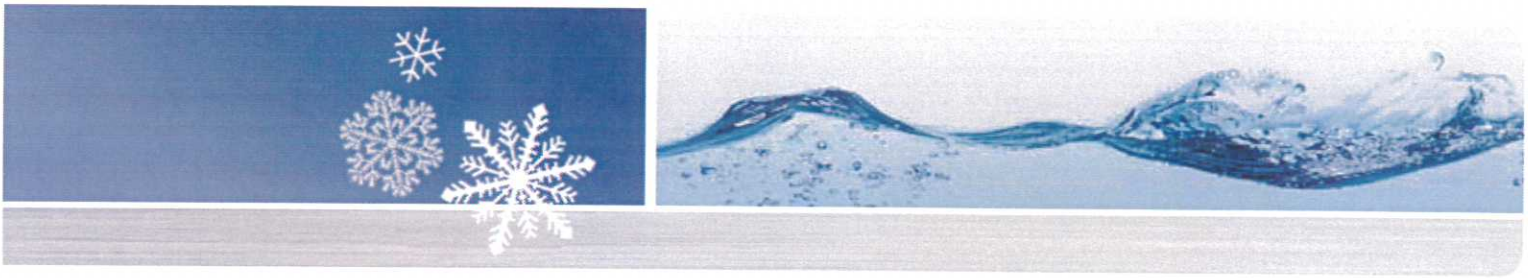
The cloud point of a #2 fuel is 10°F.

Q. ***How do I get the cloud point to -5°F?***

A. Create a 50% #1 - 50% #2 blend.

Tips to properly blend down your tank:

- If fuel in tank is at or above its cloud point, biodiesel or cold flow additives will stratify or not blend into the fuel (causing filter plugging).
- Make sure fuel temperature is at least 10 degrees above cloud point before blending down.
- Adding 10% of #1 fuel typically reduces cloud point of fuel by 3 degrees.
- Note: Adding #1 fuel to a #2 fuel at or below its cloud point will not blend properly, unless the #1 fuel is warm enough to raise the fuel temperature above the CFPP



Impact of Cloud Point

When blending fuels or additives, the cloud point of the fuel is very important.

Fact — When blending fuels, biofuels and additives, all components must be at least 10 degrees above their cloud point.*

Example:

A customer is taking delivery of fuel to get him through fall harvest. The fuel is delivered in late November. The customer splash blends 2% biodiesel and a cold flow additive into the fuel. Is this a good idea?

Dependent on the temperature of the ***fuel*** at the time, this can be a risky proposition. If the fuel in the tank is at or below its cloud point, the biodiesel and the cold flow additive will not blend into the fuel or stratify. When biodiesel and cold flow additives are not properly blended into the fuel, they become another contaminate for fuel filters to pick up.

Common Misunderstanding:

A #1 fuel will not bring a #2 fuel that is gelled back into solution unless the #1 fuel is warm enough to bring the temperature of the blended fuel back above the CFPP.

*All fuels must be blended 5-10 degrees above the cloud point to assure proper blending.

Cold Flow Improvers

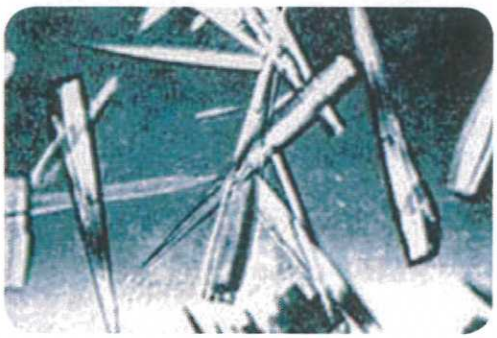
Cold flow improvers are designed to extend the operability of fuels without the use of #1 fuel.

1. Altering the Wax Structure of Diesel Fuel

Untreated diesel fuel wax structures are square in shape. As the fuel gets colder the wax structures get large enough to plug the fuel filters.

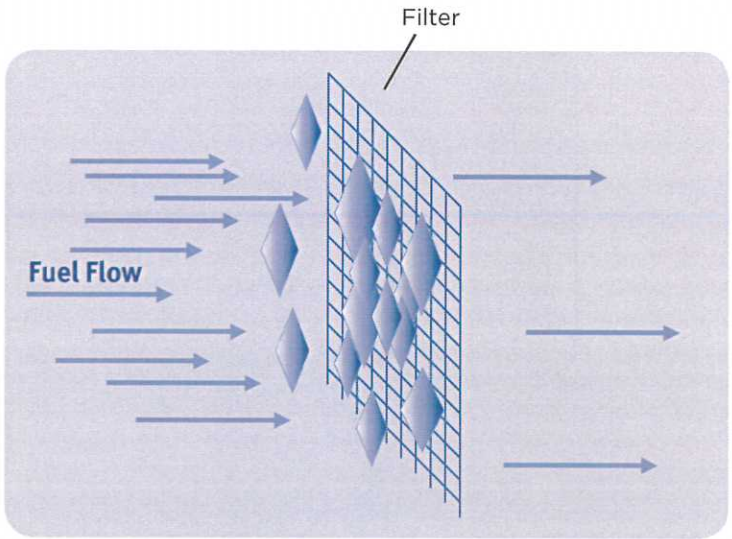
2. Dispersing Wax

Wax dispersants offer a further operability gain by keeping wax crystals dispersed for long periods of time when fuels are stored below the cloud point.



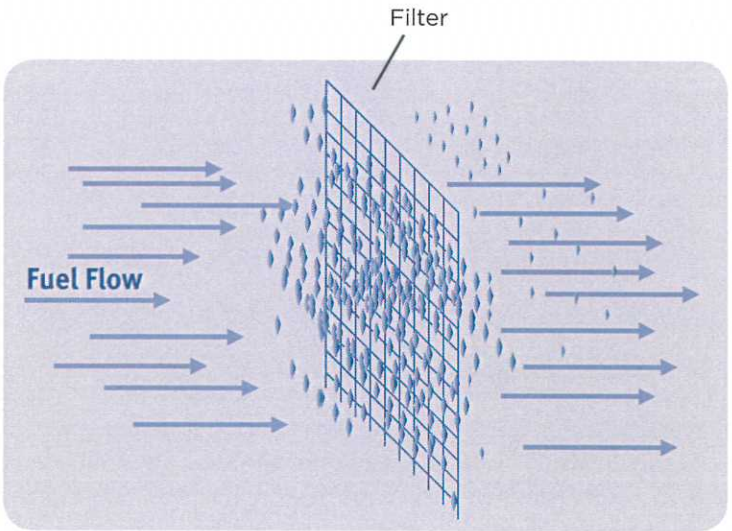
Diesel fuel treated with a cold flow improver when the diesel fuel is 10 degrees above its cloud point will change the wax structure of the fuel to a pin-like structure. This allows the wax to pass through filters at colder temperatures (extending operability).

Cold Flow Improvers – Extending Operability Wax Disposition on Filters



Without Cold Flow Additive:

Diesel fuel structures will continue to grow as the fuel temperature decreases below the cloud point. As the fuel cools, the square-like wax structures get larger and eventually plug the filter not allowing fuel to pass through.



With Cold Flow Additive:

Diesel fuel with cold flow improver changes wax structure to a more pin-like structure. This change allows fuel to pass through the filter as the pin-like structures collect on the filter and the pin-like structures pass through the filter more readily than square-like wax structures. This is what extends the operability of the fuel.

Helpful Hint:

Replace fuel filters on storage and vehicle tanks; a waterlogged filter will swell and freeze, reducing the porosity and restricting fuel flow.

Tank Maintenance

Proper tank maintenance helps ensure your fuel supply stays clean and free of harmful contaminants in your storage tank — and remains that way until it reaches your fuel system. Removing water, sediment and other impurities from the storage tank prevents them from entering your fuel system where they can lead to corrosion, filter plugging, and ice formation that severely hampers engine performance.

Water

Water gets into diesel fuel storage and vehicle tanks in several ways — by condensation of humid air, during transportation, by leakage through faulty fill pipes or vents and by careless handling. During fuel withdrawals, tanks can breathe in large volumes of humid air.

Water in the fuel can cause injector nozzle and pump corrosion, biological growth and fuel filter plugging with materials resulting from the corrosion or biological growth. In cold northern winters, ice formation in fuels containing water creates severe fuel line and filter plugging problems.

Helpful Hint:

Clean and drain water from storage tanks and equipment if you haven't already completed your fall tank maintenance.

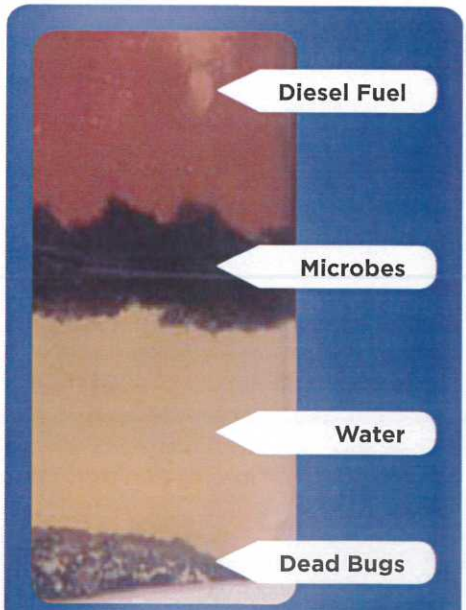
Oxidative Degradation

Biological Growth

Particulates

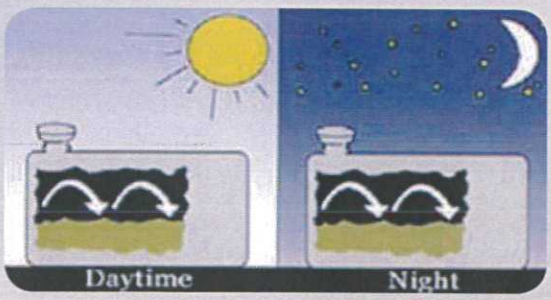
Managing the impact of water in your storage tanks is the foundation of proper tank maintenance. A significant amount of water in the tank will likely cause problems including oxidative degradation (rust, scale), particulates and microbiological growth. Follow these guidelines:

- Tilt tanks to direct water and debris away from the outlet
- Pressurize tanks to keep vapor and air inside (contact CHS Petroleum Equipment for more information – call 800-852-8186, ext. 7729, option 4)
- Drain and remove all contaminates every 3 months (or as often as needed)
- Install proper filtration systems on bulk tanks (contact CHS Petroleum Equipment for more information – call 800-852-8186, ext. 7729, option 4)
- Filters: All engine manufacturers equip their engines with fuel filters to protect the fuel system. You should replace these filters according to the manufacturer's recommendations. Some manufacturers also provide filters with drain valves and recommend periodic draining of any water that may accumulate from condensation and careless handling in storage or vehicle tanks
- Clean pump screens regularly
- Sample fuel for quality assurance purposes quarterly
- Clean tanks annually



Phase separation can happen when water is introduced to fuel. The biological growth live in the water and feed on the hydrocarbons (diesel fuel). The water and biological growth will eventually plug filters.

Tank Maintenance Diagram:



Pre-Vent Fill Cap

Fuel Sample Starter Kit

Application:

- Portable hand-operated vacuum suction pump device is designed to determine fuel conditions present in fuel storage tanks.
- For use on underground and above-ground tanks for gasoline, diesel fuels, alcohol-blended fuels, as well as fuel oil tanks.
- Oil reservoirs and drums may also be tested.

Design Features:

- 6′ x 14′ polyurethane suction hoses with brass weights.
- Equipped with three shatter-proof sample containers.

Benefits:

- Collects more accurate samples than water finding paste.
- Case is portable, easy to store and impervious to decomposition caused by fuels.
- Kit is trouble-free and will work on any size tank.
- Metal container holder will keep samples from spilling.

Replacement Parts:

#90030 – Carrying Case

#90218 – Shatter-proof Jar

#90220 – Jar Lid

Contact information:

CHS Petroleum Equipment
Toll Free Phone:
800-852-8186
ext. 7729, option 4

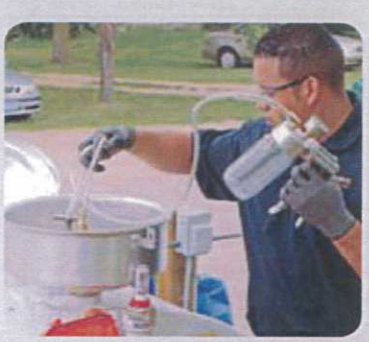
Toll Free Fax:
888-644-6384

Fuel Sample Kit — Directions for Use

1. Attach brass weight to one end of the hose.

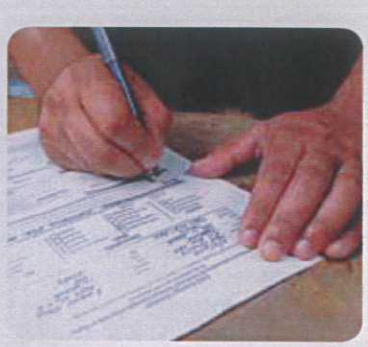
2. Attach the other end of the hose to the lid.

3. Attach jar to the lid.



4. Be sure to collect the sample from the bottom of the tank.

5. Pump sample into jar.



6. Send sample to IGH lab (order sample kits from Lubes Customer Service). Be sure to fill out all paper work including the IGH lab information form.

NOTE: The jar and hose must be cleaned with water or fuel and dried thoroughly between each sample.

Troubleshooting

Checklist of Questions

When an issue arises, the following information can help identify the source of the problem.

1. What was the **fuel** temperature at the time of the problem?

2. What terminal did the fuel come from?
   - Was all fuel in tank sourced from the same terminal?
   - Was all fuel in tank purchased from the same supplier (i.e. CHS)?

3. What type of fuel is it — Cenex® Ruby Fieldmaster®, Cenex Roadmaster XL®, Cenex Wintermaster®, Cenex® #2 or another supplier's fuel?

4. Is it a blend of #2 and #1? What percentage of #1 did you use?
   - Every 10% of #1 should reduce the cloud point of the fuel around 3 degrees.

5. Was remaining fuel properly blended down, prior to bringing in winter fuel?
   - Customers need to account for the fuel that is already in the tank (bottoms included) when figuring out how to properly blend down tanks. If there is 1,000 gallons of #2 in the tank (including tank bottoms) then 1,000 gallons of #1 would need to be blended to create a 50-50 blend in tank.

6. Was the fuel blended with biodiesel? If so, what percentage?
   - Blends higher than B5 will increase the cloud point of the fuel.
   - Splash blended or terminal blended?

7. Has the customer splash blended a cold weather additive or biodiesel?
   - Splash blending additives or biodiesel when **fuel** is at or below cloud point is not advised. Additive will likely not blend and fall out of solution leading to potential filter plugging problems.

8. Is the storage tank above or underground tank?

9. Was a bottom sample taken from the vehicle and storage tank?
   - Test kits can be ordered by calling 800-852-8186; select 8441 or 8419.
   - If filter plugging is the problem, the fuel sample taken must be before the filter.
   - Was the filter sent in?
   - Bottom samples are needed to determine if there are any contaminates in the tank.

10. When was the last time a bottom sample was taken from the tank to check for contaminates?

11. When was the last time the tank was cleaned?

12. What type of vehicle was involved? Make, model, type of filters used (paper, glass, etc.) and porosity (2, 3 or 10 micron).

13. Are OEM-recommended filters being used?

Resources / Notes

Cenex® Branded Distributor Resources

Tank Cleaning Services

Cam Vac
877-822-FUEL (3835)
www.camvacusa.com

Optic Fuel Clean, Inc.
866-936-7842
www.cleanfuelguys.com

Tank Filters and New Tank Programs

CHS Petroleum Equipment
800-852-8186 – Option #4

Cenex Fuel Related Questions

Product Specification Sheets, Material Safety Data Sheets
www.cenex.com, Products and Services, Fuels, Brands / Products

CHS Technical Services
800-852-8186 – Option #3, Option #2

Biodiesel Information

National Biodiesel Board
www.biodiesel.org

Notes

Item #270002

CENEX

OUR ENERGY COMES THROUGH.®

A BRAND OF CHS