

# **Diesel fuel in winter**

## **The effect of cold weather on fuel systems**

### **INTRODUCTION**

All diesel fuel contains wax molecules. These are natural components of the crude oil that diesel is produced from. Wax is actually an important diesel component as it has a high cetane value, which provides good ignition quality.

In severe winter conditions, especially in inland or high country areas, where the diesel gets cold enough, the wax will start to crystallize (solidify). If enough wax crystals form they will block the fuel filters, fuel strainers and fuel lines in diesel powered engines and machinery. As a result it may become difficult or impossible to operate them. This phenomenon is known as 'waxing'.

In New Zealand the legal specification for diesel varies seasonally. In winter, fuel manufacturers are required to produce diesel in which the formation of wax crystals form at a lower temperature. This reduces the likelihood of waxing occurring, with the resultant operational problems. It is important, therefore, that in winter you use winter grade fuel.

It is important to note that fuel quality is only one of the factors that may contribute to blockages in colder weather. Even if winter grade diesel is used, fuel systems may become blocked as a result of poor design, inadequate protection or poor maintenance.

This bulletin provides information about using diesel fuel in winter, in particular how you can prevent waxing occurring and what steps you can take to remedy blockages if they have occurred.

NOTE: The information provided is, of necessity, generalised and is not intended to be relied on as advice in every circumstance. Should you have any doubt as to what you need to do when problems arise, you should seek further advice from your equipment supplier. Z Energy is also happy to assist wherever possible. Call our Technical Helpline on 0800 474 355.

### **MORE ABOUT WAXING**

#### **The Cloud Point (CP)**

As the temperature of diesel is lowered, the temperature at which wax is first seen to crystallise is called the cloud point. Wax cannot block fuel filters at temperatures above the fuel cloud point because no solid wax is present.

#### **The Cold Filter Plugging Point (CFPP)**

The CFPP test provides a means of predicting the behaviour of diesel fuel in cold weather. It measures the flow of these fuels through a well-designed system under conditions that simulate actual operation.

NOTE: CFPP is not a guarantee of minimum operating temperature. Minimum Operability is controlled by a combination of fuel characteristics and fuel system design.

#### **Fuel specifications**

All diesel supplied in New Zealand is required by law to meet certain minimum specifications. These specifications are set by the Ministry of Energy and are contained in the current edition of the Petroleum Products Specifications Regulations.

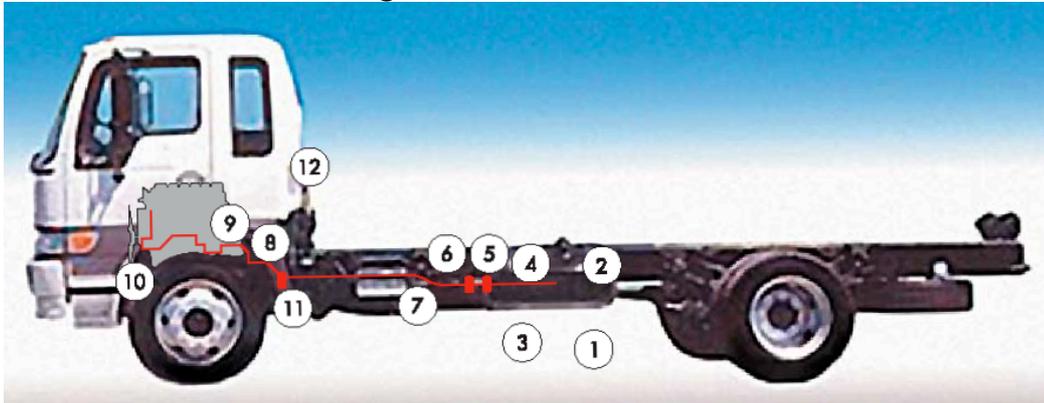
The specification for diesel cold properties varies seasonally. For winter grade diesel the legal limit for CFPP is minus 6°C maximum. Most winter grade diesel fuel in New Zealand is treated with an additive to reduce the CFPP. These additives do not reduce the temperature at which the diesel goes cloudy (cloud point) but does reduce the temperature at which the diesel will stop flowing. So although the temperature may be below the diesel cloud point, and the diesel will be cloudy, if the diesel is above the fuel's CFPP then the diesel will still flow and will not immediately result in filter blocking problems.

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## Shell diesel

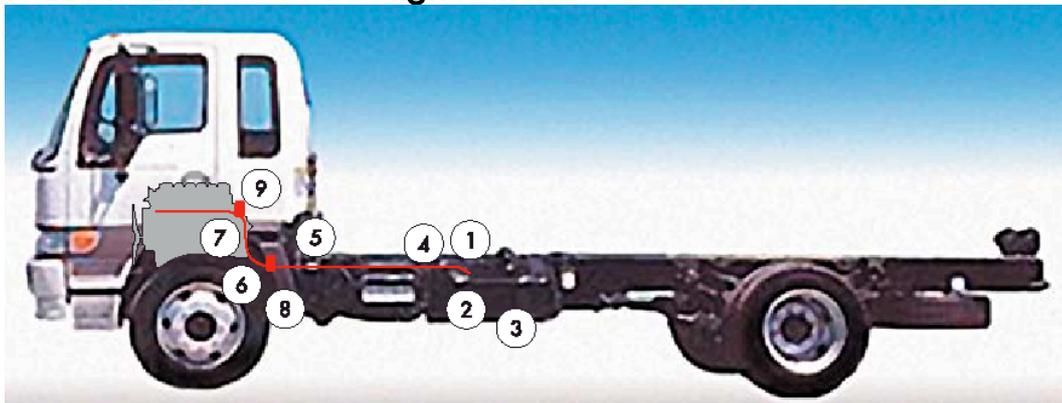
All Shell winter grade diesel, supplied by Z Energy, meets or exceeds the legal specifications. Winter grade diesel supplied to the Northland and Auckland regions is suitable for use in temperatures down to minus 6°C. For colder regions such as Otago or Southland, Z Energy supplies a special winter grade diesel suitable for use in temperatures down to minus 15°C. For the rest of New Zealand Shell winter grade diesel is suitable for use at temperatures down to minus 9°C.

### VEHICLE FUEL SYSTEMS - Poor design features



- |  |   |
|--|---|
| 1. Exposed fuel tank location.                       | 8. Sharp bends and U-bends in pipe work.  |
| 2. Poor filler/vent location allowing water ingress. | 9. Lengthy narrow bore metal pipe work with excessive number of elbow joints with changes in bore size. |
| 3. No fuel tank drain.                               | 10. size.   |
| 4. Fine mesh screen fitted at tank outlet.           | 11. Pipe in line with fan.  |
| 5. Exposed fine pre-filter.                          | 12. Main filter in exposed position.  |
| 6. Exposed water trap fitted with fine screen.       |   |
| 7. Exposed pipe runs.                                |   |

### VEHICLE FUEL SYSTEMS - Good design features



- |  |   |
|--|---|
| 1. Large bore nylon pipe.              | 7. Large radii bends on all pipes. Lines run in a sheltered, warm location. |
| 2. Tank located in sheltered position. | 8. Sediment or water separator without gauze screen or fine pre-filter.     |
| 3. Drain plug fitted to tank.          | 9. Main filters mounted on engine in warm position                          |
| 4. No screen at tank outlet.           |   |
| 5. Screen on filter.                   |   |
| 6. Constant bore pipe work.            |   |

## OTHER CAUSES OF BLOCKAGES

The limits described above provide an acceptable performance level during a typical winter for the great majority of New Zealand's diesel users. However fuel quality is not the only relevant factor when considering the cause of blockages. Blockages can occur at temperatures warmer than specified if the fuel system has not been well designed, adequately protected or properly maintained. For example, exposed tanks, pipes and pumps can act as radiators that quickly cool the fuel causing wax to form in fuel lines and accumulate at the bottom of tanks blocking off-take lines.

Water may also be a factor. Diesel has some water dissolved in it, even when it appears clear and bright. This will begin to condense as the fuel temperatures drop below 10°C. If water is not removed from the storage tank by frequent draining, then water in suspension in the fuel will form ice crystals when the temperature is below 0°C, but still too warm for the diesel wax to become visible.

The rest of this bulletin provides hints on how to prevent waxing in vehicles and heating installations. We have also provided diagrams showing examples of poor and good design features. Needless to say, prevention is much better than cure. However we have also provided some hints on how to remedy blockages should they occur. For further information and advice, call our Technical Helpline 0800 474 355.

## WAX PREVENTION IN VEHICLES

1. The specification for diesel varies seasonally; this is done to ensure that the fuel available is appropriate for the normal ambient temperature. Because the summer diesel has a warmer cloud point and CFPP, it is not appropriate to use summer diesel during the winter.

To avoid winter waxing problems use up your stocks of summer grade fuel and restock with winter grade in autumn, some time in April should be suitable.

If you try to blend winter with summer diesel, the summer diesel has the greater effect and you will require significantly more winter diesel to change the diesel cold properties. It is important that summer fuel should not be kept for winter use.

2. Check that the fuel system does not include items that are likely to prove sensitive in cold weather (see diagrams). If it does, then ideally the system should be modified. If this isn't possible, insulate all exposed pipe work and filters before the onset of cold weather. Sophisticated protection may not be required – even corrugated cardboard wrapped around filter bowls has proved effective.
3. Regular maintenance is essential. Standards of maintenance, which are acceptable during the summer, may not prove adequate in cold weather, so ensure that servicing is carried out meticulously. Check the fuel tank, filters and sedimenter, and remove any water or grit. Water freezing in the fuel system will cause problems well before waxing.
4. Change fuel filters at the manufacturer's recommended intervals. Always carry a spare set of filters - it's much easier to replace a filter than to clear a blocked one.
5. Whenever possible, garage vehicles overnight. When this cannot be done, shield vehicles from the wind by parking next to a wall or erecting a windbreak.

Vehicles should not be parked in low-lying areas prone to frost. In exceptionally cold weather, parked vehicles can benefit from having their engines left idling or run for a short while at frequent intervals. It is also worthwhile idling the engine to allow the fuel system to warm up before exposing the vehicle to extreme cold temperatures.

6. Install diesel fuel tank or fuel filter heaters in vehicles that are likely to be exposed to extreme cold temperatures. These heaters warm the fuel up so that no wax crystals will form.

## Remedies

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Wax prevention is much better than cure. You should follow the wax prevention steps detailed above. However, once waxing has occurred it can only be eliminated by either, physically removing the blockage, or warming the fuel to re-dissolve the wax crystals. No suitable solvents or additives are available that will dissolve wax once it is present in the fuel. First check that the cause of the stoppage isn't ice. Unfortunately it is very difficult to tell the difference between fine ice crystals and wax, so it is far better to ensure that water isn't present in the first place.

If wax is to blame, remove or change the fuel line filter. Fine mesh screens fitted in the fuel tank are a common source of difficulty. Apply gentle heat to the fuel system (filter body and fuel lines). Hot water, steam cleaners, fan heaters or even a hair dryer can be used. Then start the engine and run until the system is warm.

Under no circumstances should a naked flame be used on any part of the fuel system or fuel tank. NEVER ADD PETROL TO THE FUEL. The addition of petrol could be extremely dangerous and it is also unlikely that it will dissolve wax.

### WAX PREVENTION IN HEATING INSTALLATIONS

1. Screen the storage tank from the wind. Cold winds can reduce bulk fuel temperatures dramatically, resulting in the formation of wax in the fuel.
2. Insulate all exposed pipe work and filters with waterproof lagging, paying particular attention to the filters. Check the line for kinks and other constrictions that would impede the flow of fuel.
3. Check that the material in which any pipeline is buried is dry. Ice forming around the pipe work will cancel the insulating effect of the mortar.
4. Check on the practicality of moving exposed filters to a warmer location.
5. Regular maintenance is essential. Filters, for instance, should be cleared as a matter of routine. Remember, too, that over a period of time some water may have accumulated in the bottom of your tank because of moisture in the air. Ideally this water should be drained off before each delivery, but certainly before winter starts, so as not to cause icing that could block filters. To detect the presence of water, draw small samples of fuel from the tank and filter bowl into clean dry bottles and allow to stand. Any water will tend to separate as a clear layer or small globules at the bottom of the bottles.
6. Practice good stock rotation. To avoid winter waxing problems use up your stocks of summer grade fuel and restock with winter grade in autumn, some time in April should be suitable. If you try to blend winter with summer diesel, the summer diesel has the greater effect and you will require significantly more winter diesel to change the diesel cold properties.  
It is important that summer fuel should not be kept for winter use.
7. Install a diesel fuel tank heater to warm the contents of the tank and eliminate the formation of diesel wax.

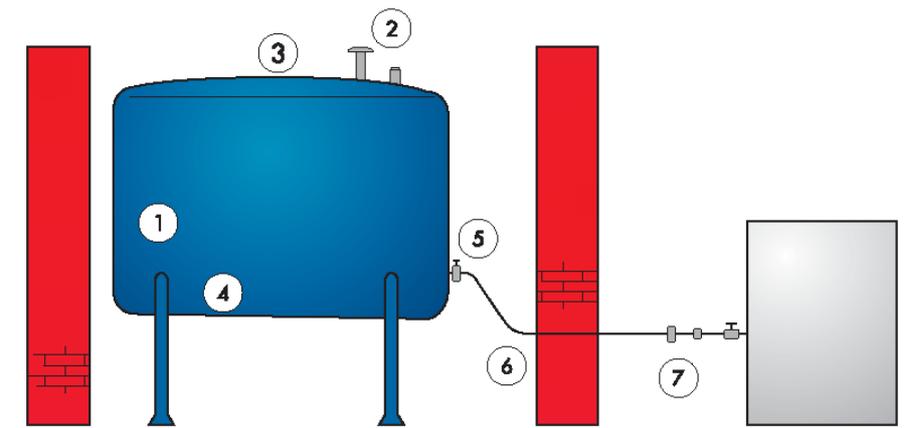
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If waxing has definitely occurred, gentle heat applied to the pipe work should cure the problem. Hot water, fan heaters, even hair dryers should be adequate. Pay particular attention to the fuel filter if it is located in an exposed position. If necessary, and as a temporary measure, remove the filter element to clear the fuel lines.

Under no circumstances should a naked flame be used on any part of the fuel system or fuel tank. NEVER ADD PETROL TO THE FUEL. The addition of petrol could be extremely dangerous and it is also unlikely that it will dissolve wax. Once the burner is working again, follow the preventative tips to ensure the problem won't recur.

## HEATING INSTALLATIONS - Good design features



1. Fuel tank sheltered from the effects of wind chill.
2. Fill and vent pipes fitted with caps.
3. caps.
4. Tank top shaped to shed water. Tank sloped away from off-take point (1 in 50 slope) with suitably positioned and accessible sludge cock.
5. Isolating valve insulated. Have the off-take point well clear of tank bottom.
6. Shortest practicable fuel lines with no sharp bends located in a sheltered position and insulated with waterproof material.
7. Filter mounted close to boiler or located in a warm environment.

The same principles apply to industrial and agricultural heating plants. Similar precautions should also be taken with bulk diesel fuel storage installations.

### IMPORTANT INFORMATION

This bulletin provides information about using diesel fuel in winter, in particular:

- how you can prevent waxing occurring in your vehicle or heating installation, and
- what steps you can take to remedy blockages if they have occurred.

Diesel fuels are complex mixtures of hydrocarbons. As they cool down they don't 'freeze' at a single temperature like water; instead one of their essential components tends to form minute wax crystals, which remain suspended in the fuel. These crystals need not create problems unless they become large enough to get trapped in the fuel system and form a blockage.

The lower the temperature of the fuel, the greater its tendency to form wax crystals. The limitation on the use of diesel fuel at low temperatures, therefore, is dependent on the amount of wax present and the fuel system's ability to avoid the build up of wax crystal collection in filters, small diameter pipes or water separators.

### Technical Bulletin

For further information contact the Z Energy Limited Technical Helpline:  
Free Call 0800 474 355  
Free Fax 0800 743 553